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5—Journal Section of the American Society of Heating and Ventilating Engineers

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Don't wait until cold weather catches up with you to correct last winter's heating headaches. Now is the time to do something about it for next winter.

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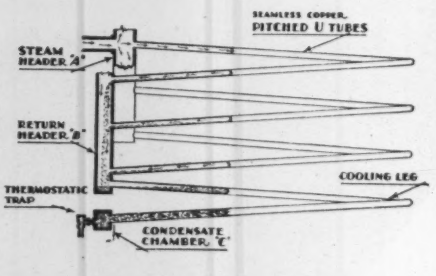

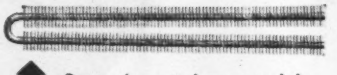

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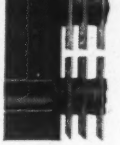

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WHENEVER **PIPING** IS INVOLVED

THE EDITOR'S PAGES

SAFETY HAZARDS IN AIR CONDITIONING SYSTEM

A friend of ours who is concerned with the maintenance of the mechanical equipment in several large buildings managed by his firm is worried about some of the installation details of a new air conditioning system serving a theater in one of the buildings. The theater put the system in, so he had nothing to say about its design.

One thing that bothers him—when he thinks of the servicing and operation of the equipment—is a narrow catwalk, poorly lighted, and with no handrails. Looks very much like a safety hazard. And to make matters worse, it would be possible to climb through a small access door from this catwalk into one of the ducts and drop down a whole story without warning.

Several of the fan motors are inside the fan housings, which is going to make it difficult to service them. Worse than that, he feels, is the likelihood of smoke from an overheated motor being distributed to the occupied space.

AIR CONDITIONING BUSINESS UP

During the 12 months ended April 30, Carrier Corp. completed contracts and sales of $55,050,376 as compared with $37,450,297 in the previous similar period. New orders booked totaled $46,139,159 as against $46,120,124 for the preceding 12 months.

Net profit for the period was $2,349,697 after provision for taxes, certain nonrecurring expenses, and a reserve for contingencies. This compares with $1,570,336 for the 12 months ended April 30, 1947.

FUEL OIL STANDARD IS REVISED

A recommended revision of the commercial standard on fuel oils, No. CS12-40, has been submitted to producers, distributors, and users of this product for written acceptance, according to the commodity standards division of the National Bureau of Standards, Washington 25, D. C. The purpose of the revision is to bring the standard into line with current refinery practice and burner construction. The specifications cover five grades of fuel oil for various types of fuel oil burning equipment. A suggested form of identification, to indicate compliance with the commercial standard, is also included.

Upon request, mimeographed copies of the recommended commercial standard may be obtained from the commodity standards division.

TO STUDY DESIGN, PLANNING OF SCHOOLS

The Producers' Council, 815 15th St., N.W., Washington 5, D. C., national organization of building products manufacturers, will cooperate with the American Institute of Architects, the U. S. Office of Education, and others in a study of the design and planning of schools and school equipment, David S. Miller, council president, has announced.

"The council has agreed to participate in the formation of a joint committee of architects, educators, and school construction specialists for the purpose of devising a program of practical research in school planning and construction methods," Mr. Miller said.

"The need for research in this field is demonstrated by the fact that nearly 3000 new school buildings were erected last year and the probability that that number may be exceeded this year and next.

"The steady increase in the number of children and students attending school, the general increase in building costs arising from wartime conditions, and budgetary limitations in many localities have brought new problems in the planning of schools and require concentrated study by everyone concerned," he stated.

ATOMIC ENERGY DEMANDS AIR CONDITIONING SKILL

Dr. O. C. Simpson, associate director, chemical division, Argonne National Laboratory, Chicago, last month called upon the nation's engineers to turn their professional skills to the solution of many problems of atomic energy research, declaring that it is "highly essential that the number of technical people with atomic energy research know-how be greatly expanded if the United States is to retain its pre-eminent position in this field."

Speaking in Milwaukee before the American Society of Mechanical Engineers, at a luncheon featuring its semi-annual meeting, Dr. Simpson defined eight general problems, among which are:

Remote control engineering which "may be the most important single field in the future development of atomic energy." This would include an "automaton" with apparatus to carry on operations in airtight structure heavily shielded against the deadly radiation damage.

Air conditioning and ventilation of radiochemical laboratories, necessary for use with hazardous gases or radioactive particles of matter.

The air conditioning and ventilation equipment for a modest radiochemical laboratory may cost several hundred thousand dollars, the Argonne chemist said—"and not one cent for the comfort of the researchers!"

"Such expensive installations are required mainly to supply large linear air velocities through the faces of various radiochemical hoods or other special cubicles designed for use with hazardous gaseous or particulate radioactive materials. At the present time there is an imperative need for a more adequate design of radiochemical hood," he stated.

GAS AIR CONDITIONING AWARD ANNOUNCED

L. L. Ladewig, chairman of the all-year gas air conditioning committee of the American Gas Association, 420 Lexington Ave., New York City, has announced that the first annual AGA progress award for gas summer air conditioning will be made at the association's convention, October 4-8, at Atlantic City. It will be based on progress made during 1947. Donor of the award is Servel, Inc.

The award will be the "progress trophy" and $1000 in cash to the winning company. Miniatures of the trophy will be presented to the individuals in the company whose efforts made the award possible.

Entries must be in the hands of the AGA by August 1.

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THE EDITOR'S PAGES

"PATTERN" OF GAS A.C. CHANGING

The current year is bringing "a marked change in the pattern" of gas all-year air conditioning. Electric utilities in some areas now are discussing the possibilities of promoting sales of certain types of gas all-year air conditioning, according to the American Gas Association.

Air conditioning with gas as a fuel offers especial attraction to electric utility companies in certain areas because of its inherent possibilities, says the AGA.

Economic factors are causing an increasing number of gas utility companies to include promotion of air conditioning in their new sales programs. Restrictions on sales of gas house heating are gradually lifting. With the gas air conditioning load to fill the valleys during the summer months, a total system load that will yield a year 'round profit can be achieved.

Gas utilities often have been asked whether or not the reversed refrigeration cycle, discovered nearly a century ago and today being publicized as the heat pump, is not applicable to gas. Manufacturers of heat pumps today are producing this equipment for operation with gas as a fuel. With suitable equipment in the building this process can be applied either to winter heating or summer cooling or to both.

JAMES M. TODD TO HEAD ASME

James M. Todd, New Orleans consulting engineer, has been nominated as the next president of the American Society of Mechanical Engineers. Nomination is tantamount to election since only one name is presented for each office; formal election will take place in the fall by letter ballot of the membership, which totals more than 25,000 engineers throughout the United States. The 1948-49 term will begin at the end of the annual meeting next December.

Mr. Todd contributed an article, Modernizes and Profits with Air Conditioning, to the January 1933 HPAC, describing the installation at the D. H. Holmes department store in New Orleans.

Other ASME officers nominated are, as regional vice presidents, Arthur Roberts, Jr., chief engineer, Lynchburg Foundry Co.; Forrest Nagler, chief mechanical engineer, Allis-Chalmers Mfg. Co.; Carl J. Eckhardt, professor of mechanical engineering and superintendent of utilities, University of Texas; and Albert R. Mumford, development engineer, Combustion Engineering Co.; and, as directors-at-large, Jacob A. Keeth, manager of power production, Kansas State Power and Light Co.; and Ralph A. Sherman, assistant director, Battelle Memorial Institute.

DEMAND FOR PRODUCTS ACTIVE, IBR HEARS

Continuation of short courses, research, consumer advertising, the development of a field training program, and the expansion of the series of installation guides were among the subjects discussed at the semi-annual meeting of the Institute of Boiler and Radiator Manufacturers at Absecon, N. J.

An active and well-sustained demand for boilers, radiators, baseboards, convectors, controls, and accessories throughout 1948 and subsequent years was predicted by the members and associate members of the institute.

Radiation is being sold as rapidly as it can be produced, large boilers are moving fast, and wholesalers have normal stocks of small boilers, it was reported at the meeting.

Carroll M. Baumgardner, executive vice president of the United States Radiator Corp. and chairman of the institute, presided over all sessions.

R. E. Ferry, general manager of the institute, reviewed the highspots in the activities of the institute during the last 10 years. He said that 23 technical and promotional committees are actively functioning and that in the 10 year period they held 322 separate meetings.

Members of the institute authorized the continuation of the research program at the University of Illinois, as recommended by the research committee. L. N. Hunter, vice president of the National Radiator Co. and chairman of the committee, recommended nine research projects, including the determination of the cost of heating water in the summer with a gas fired boiler and internal and external storage type and tankless heaters; determination of the effect of storage tank size on performance of storage type heaters; and the determination of the cost of heating water in winter with a gas fired boiler on external storage type heater and external tankless heater.

MARKS 100th YEAR, SEES CAPITAL GOODS INCREASE

An increase—and not, as frequently predicted, a leveling off or decline—in volume of capital goods sales may reasonably be expected by heavy equipment manufacturers in the next few years, according to a statement last month by Edwin A. Stillman, president of the Watson-Stillman Co., before a management group of the Roselle, N. J., organization on the occasion of its 100th anniversary.

Sale of forged steel pipe fittings and valves is proceeding at such a rate as to tax production facilities of the company's distributor products division, Mr. Stillman said. Forged stainless steel and alloy fittings, he added, are on the increase throughout industry for corrosive, high temperature, and high pressure applications, and welding fittings continue to discover new applications.

JONES HEADS ACRMA

George S. Jones, Jr., vice president in charge of sales of Servel, Inc., was elected president of the Air Conditioning and Refrigerating Machinery Association at the annual convention at Hot Springs, Va. Ross Rathbun, president of the Baker Ice Machine Co., was named the association's first vice president; George R. Prout, vice president of the General Electric Co., second vice president; and P. A. McKittrick, vice president, Parks-Cramer Co., treasurer.

Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

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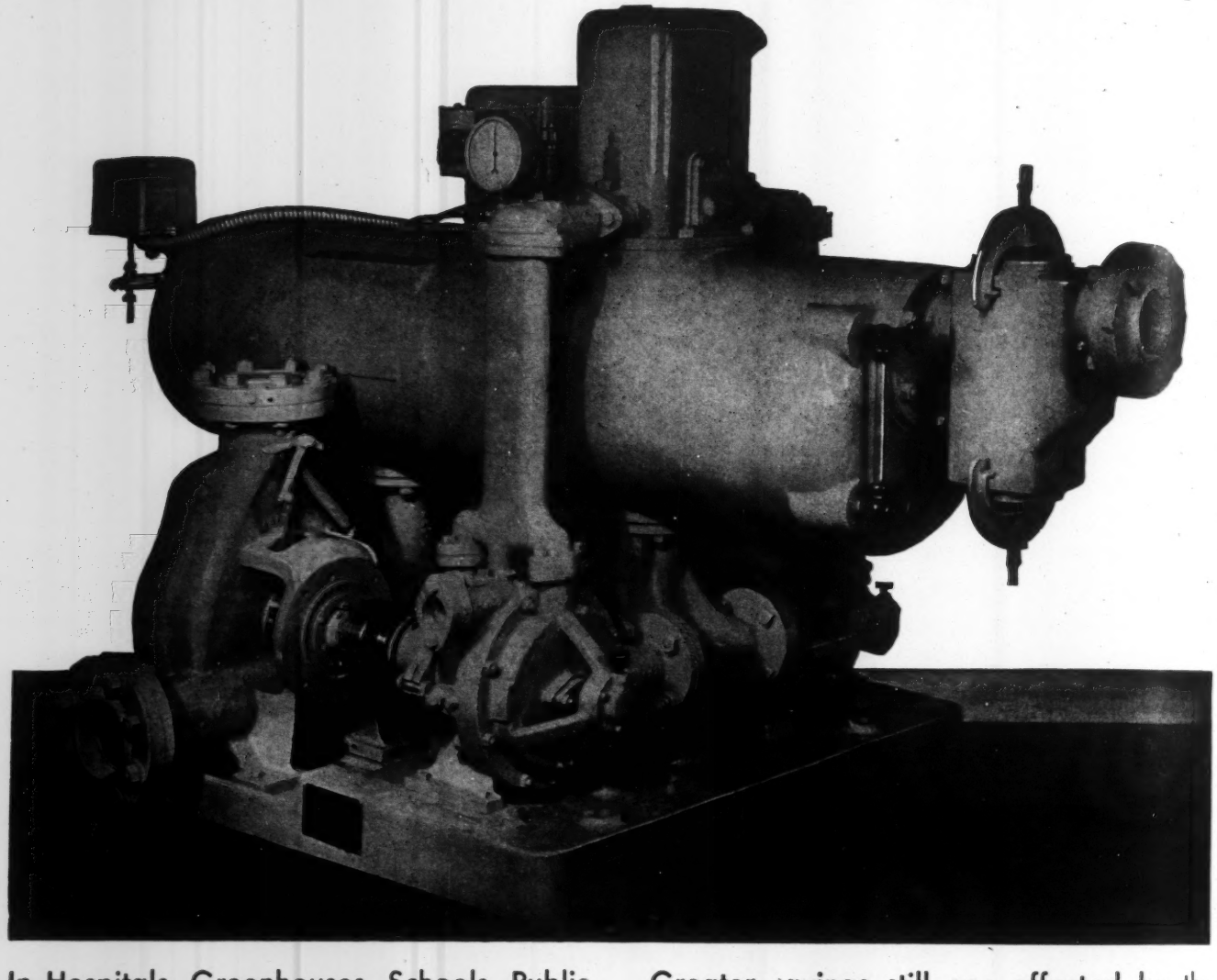
Where Heat Must Not Fail— Install this SAFE Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is entirely independent of electric current failure, and continues to operate as long as there is steam in the system.

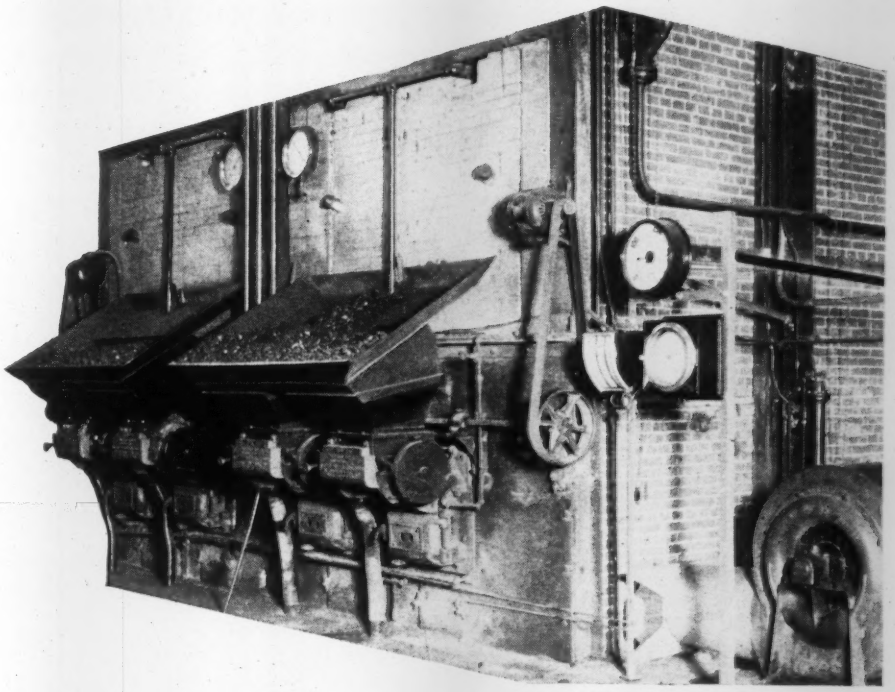
More than that, the Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump.

Greater savings still are effected by the Vapor Turbine in the system, for the reason that this pump operates continuously. It is the only pump that can do this with economy. Continuous operation means uniform circulation, and uniform circulation saves steam.

The Nash Vapor Turbine has but one moving part, rotating in the casing without metallic contact, and requiring no internal lubrication. Quiet, compact, and trouble-proof. Bulletin A-290 is free on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.



Boiler plants for process—and for heating factories, institutions, hotels, and the like—are among the spreader stoker's applications

Wide Range of Coals Can be Burned With Spreader Stoker

KALMAN STEINER and ROBERT H. WILDER explain the advantages and operating principle of the spreader stoker, with practical comments on its application for heating and process work. Ability to burn a wide range of fuels, flexibility in handling load fluctuations, high combustion rates per square foot of grate, and good efficiency with low maintenance, are among the features of this equipment. Mr. Steiner, a member of HPAC's board of consulting and contributing editors, is with the C. Hoffberger Co., Baltimore, and Mr. Wilder is with Plibrico Sales & Service Co.

DURING THE PAST 10 to 15 years the spreader stoker has enjoyed a considerable success, attaining widespread acceptance. For a relatively new method of burning coal, this is rather a remarkable record. A brief summary of its advantages will reveal why the spreader stoker has made rapid strides.

The spreader stoker combines burning coal in suspension with burning on a grate, like older methods. Its outstanding features are:

1) Ability to burn an unusually wide range of fuels, the spreader being practically independent of moisture, volatile content, ash content, ash softening temperature, and caking tendency.

2) Flexibility in handling a wide and rapid fluctuation in load.

3) Ability to burn coal at high rates per square foot of grate area without clinkering difficulty.

4) Ability to attain high operating efficiency and incur but low maintenance cost.

A study of the operating principle of the spreader stoker reveals it to be essentially a means of distributing coal in a uniform pattern on a grate, usually by means of a series of rotating arms that fling or impel the coal forward but in at least one form a stream of air, mixed with and heated by furnace gases, is used to convey and distribute the coal. This design incorporates coal handling up to distances of 100 ft. The finer coal particles burn in suspension; the heavier fall on to a specially designed grate and are burned rapidly because of forced draft causing air to rise upward through grate and fuel bed. An important characteristic of operation is the fact that the fuel bed is thin and need not be disturbed, as will be brought out later.

The spreader stoker may be ap-

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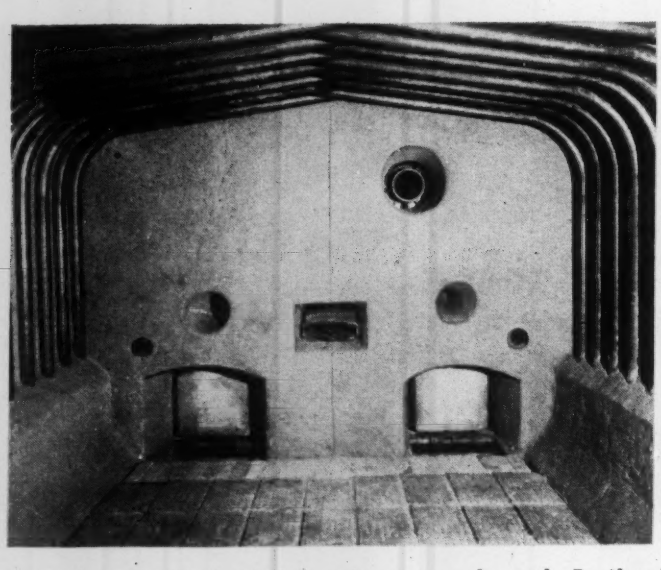
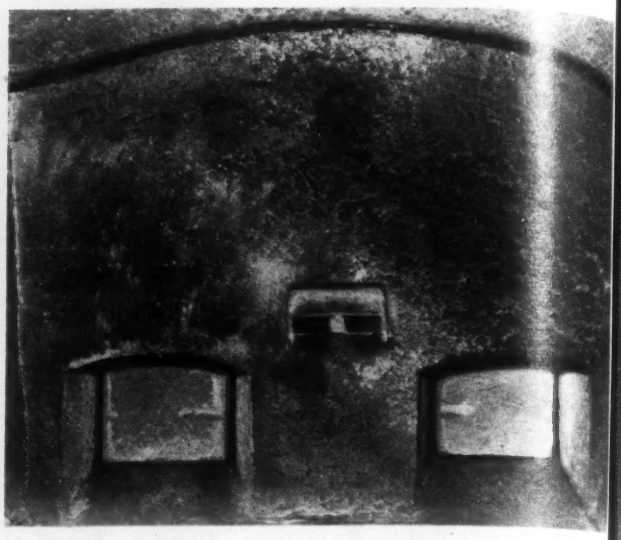




Left: Considerable latitude in choice of grate style is permitted Right: Experience shows heat release rates not exceeding 30,000 Btu per cu ft per hr are advisable with refractory furnace walls. The rate may be increased with water wall furnaces

plied to any kind of fire tube or water tube boiler. The usual range in grate width is from 4 ft to 28 ft, and of grate length from 5 ft to 17 ft. Practically, applications to boilers smaller than 100 hp in some types and 150 hp in others are not feasible. On the maximum end, there is hardly any limit to boiler capacity for the stoker. It lends itself well to moderate sized boiler plants for process or for heating factories, institutions, hotels, and the like.

The most popular size of coal seems to be standard 1¼ in. to 0 or ¾ in. to 0, although smaller and larger sizes are used—up to as large as 2½ and even 3 in. with certain makes. Smaller sizes tend to build a more uniform fuel bed, however, and are also more suitable for the longer grates. The pneumatic spreader burns fine sizes such as ¼ in. to 0.

The spreader stoker permits a considerable latitude in choice of grate style. The principal distinction is between intermittent and continuous cleaning. In the former class are two types—stationary grates and dumping grates; the continuous ash discharge grate is a travelling grate. Dumping grates, in turn, may be either hand operated or power operated. Neither the dumping nor travelling grate requires any working of the fire. Only in the case of the stationary grate is any disturbance of the fuel bed called for, and then only for removing ash.

Both stationary and dumping grates are cleaned sectionally; that is, the forced draft for a given section of grate is shut off and its fire cleaned. In the dumping grate this involves no more than tipping the grate bars to eject the entire fuel bed over that section. With stationary grates, however, the burning fuel must be moved to another section of the grate while the underlying ash and clinker are pulled from the firebox.

The continuous ash discharge assembly resembles the chain grate mechanism of earlier travelling grate stokers. But significant differences are immediately apparent. The travelling grate of a spreader uses no arches; because of the thin fuel bed, combustion is almost instantaneous. In fact, the continuous ash discharge grate of a spreader can be arranged for either forward travel, as with the chain grate, or backward travel, returning the ash toward the furnace front. The speed of the continuous ash discharge travelling grate is variable up to about 12 ft per hr.

Responds Quickly to Rapid Load Changes

Combustion rates vary from 20 lb per sq ft per hr with stationary grates to 40 lb with dumping grates, and somewhat higher with a travelling grate. These values, however, are not fixed, the principal variables being the quality of coal being burned, construction of the furnace as to refractory and water wall, and fly ash. The fuel bed of a spreader stoker is characteristically thin, holding only a few minutes fuel supply.

The spreader responds quickly to rapid changes in load. This is made possible by close coordination of fuel feed and air delivery and accurate proportioning of both to prevailing load. The usual combustion controls are applicable to this stoker, any hydraulic or electrical master controller responding to changes in steam pressure in turn causes coal feeder, forced draft fan damper and uptake damper to assume positions that will alter the combustion rate accordingly and still maintain high CO_2. The low fuel storage in the firebox means almost instantaneous response in the steam generating rate.

It is possible by means of grate orifices to introduce the air supply not only in even distribution over the entire grate area but in channels directed at various angles thereby greatly promoting turbulence over the fire and enhancing the intimacy of air-fuel admixture. With high volatile fuels this constitutes an important antismoke device. The method of introducing air through grate orifices results in a multitude of individual flames, each somewhat resembling the bunsen flame.

Where needed, overfire jets may also be employed to abate smoking.

Experience shows that the furnace of a spreader stoker installation should be designed for a continuous heat release rate not exceeding 30,000 Btu per cu ft per hr with refractory furnace walls. Higher heat releases may be justified for peak loads. However, the rate may be increased to between

40,000 and 50,000 with water wall furnaces, but it should be borne in mind that water walls absorb radiant heat at high rates and tend to reduce furnace temperature. Where higher furnace temperatures are desired, especially to suit light load conditions, a common compromise is to cover the lower portion of a water wall with refractory.

Conditions prevailing in the furnace of a spreader stoker may be unusually severe on the refractory of the side walls at high ratings unless special furnace design is used. The trajectory of the coal particles at the sides of the furnace causes a constant attrition of the refractory surface. Ascent of fly ash in the same region adjacent to the furnace walls brings incandescent ash particles into contact with equally hot refractory, with the usual result that a slag is formed having a softening temperature lower than either of the two constituents that formed it, followed by erosion of the furnace wall. Prevention of this condition is attained by keeping the grate narrower than the furnace width. The pocket between the edge of grate and the walls greatly minimizes contact of fly ash with refractory.

Success Due to Solving Fly Ash Problem

The greatest single deterrent to the early exploitation of the spreader stoker was the fly ash problem. As already mentioned, the finer coal particles are burned in suspension, leaving a light, flocculent ash that does not settle to the grate but is carried upward with the combustion gases. The story of the expanding use of the spreader is largely the story of the successful solution of the fly ash problem.

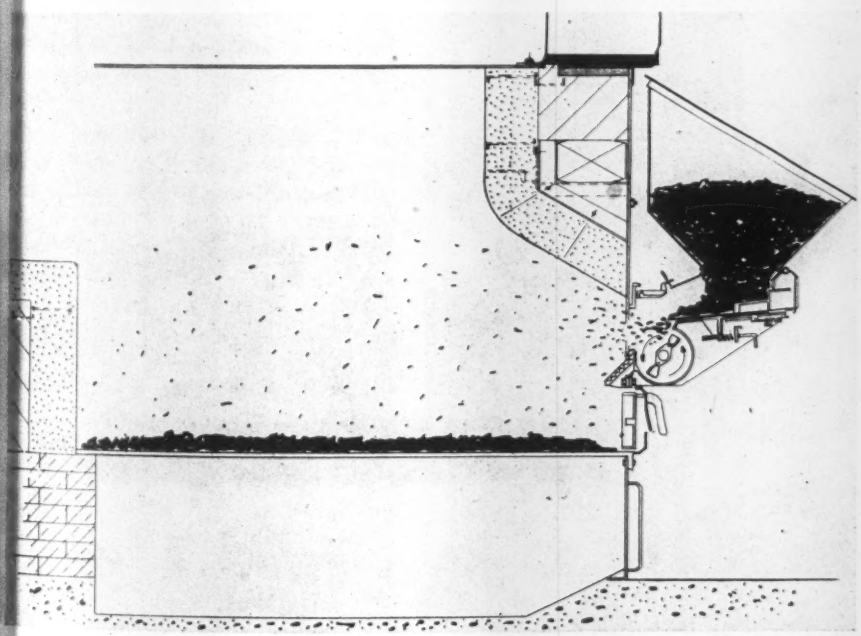
In larger plants, rather elaborate equipment is installed to handle fly ash—cyclone separators in the breeching to throw out the ash particles, induced draft fans to overcome the resistance of the separator, and a system of recirculating the precipitated ash through the firebox in order to consume any remaining carbon that escaped combustion on the first passage through. For small and medium sized plants, there is available a type of equipment with low draft loss (not exceeding 0.25 in.), that will remove about 85 percent of the ash particles larger than 200 mesh.

Power Required for Spreader Stokers

The power requirement of the spreader varies with the type of installation and the kind of fuel burned. The operation of the coal feeder can be considered to require about 1/3 kw per ton of coal burned. Power for ash removal depends entirely upon the method; stationary and manual dumping grates require no mechanical power, but power dumping and continuous ash discharge grates require up to ½ kw per ton of ash handled. Since the total air needed for combustion of a ton of coal depends upon the amount of combustible, the power requirement is best based upon the combustible content, and averages about ¼ kw per million Btu heat release.

Maintenance on a properly installed spreader stoker is low. The matter of refractory maintenance has already been discussed. Grate destruction is not high, for the reason that grate temperature runs very close to incoming air temperature, the layer of ash under the fire and the high rate of air flow serving to prevent heating of the metal. Where there is likelihood of external parts of the stoker becoming hot by transfer of heat from the furnace, those parts — particularly bearings—are water cooled.

The spreader stoker combines burning coal in suspension and on a grate



COMPRESSORS BOOST GAS SUPPLY

The gas engine-driven compressor is currently "the most important factor in the distribution of America's heating, cooking, and industrial gas supply." So states Gordon Lefebvre, president and general manager of the Cooper-Bessemer Corp., gas engine and compressor manufacturer.

While the shortage of steel pipe continues to be one of the major stumbling blocks to an appreciably increased gas supply, Mr. Lefebvre points out, compressors on existing cross-country lines are increasing the volume of gas to consumers to an important degree.

He cites as an example the job compressors are performing for the Texas Eastern Transmission Corp., Shreveport, La., since its acquisition of the Big Inch and Little Big Inch pipe lines.

According to that company's recent annual report, the original volume of natural gas transmitted through these former government-operated oil lines was approximately 140,000,000 cu ft daily. By December 31 of last year, compressor stations built along the 1254 miles of the Big Inch line and the 1479 mile Little Big Inch line had increased the gas volume to 433,000,000 cu ft per day.

Texas Eastern is currently adding compressors to increase the daily volume to 508,000,000 cu ft, or nearly four times the original supply to consumers.

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How to Maintain and Repair

GATE AND GLOBE VALVES

R. A. HENDRICKSON, manager of oil sales, Crane Co., Chicago, tells how to prevent extensive valve damage and destruction through the periodic inspection and prompt maintenance of valve parts. "Preventive maintenance" is an idea that pays off with all types of mechanical devices.

GOOD VALVE service consists of proper selection and installation followed by prompt maintenance and repair of leaking or damaged valves. Even the best valve cannot be expected to work at its best and stay on the job if it's incorrectly installed. Nor can it be expected to stand up very long after it develops a seep or a leak.

After valves have been properly selected and installed, their maintenance can be reduced by a surprising amount through periodic inspection. Service conditions and frequency of operation will determine the frequency of inspections. But once the interval of valve inspection has been established it should be made regularly and systematically. When routine valve inspection discloses a leakage, steps should be taken immediately to correct the trouble before the valve destroys itself.

Fig. 1—When a leaky valve is discovered, remove the bonnet and examine the disc and body to determine the extent of damage

Stuffing Box Leaks

Stuffing box leakage is one of the most common troubles encountered in valves. It usually happens when improper packing is used or when packing is worn. Leaks may be evidenced by steam "flags," by unaccountable presence of moisture on piping or valve bodies, or by outright dripping. Leaks should be attended to immediately when dis-

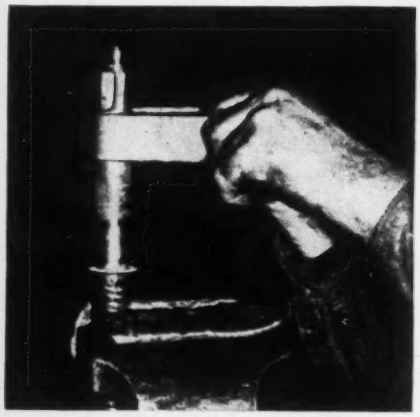

Fig. 2—Light polishing with fine emery cloth may be all that's necessary to put the stem in good condition

covered. Don't hesitate to break into insulation if a leak is suspected underneath. Such hidden leaks are especially damaging to bolts, pipe, and flanges. All leaks are conducive to corrosion.

If it is necessary to hunt a leak under pipe insulation, it is suggested—for minimum of damage to the insulation—that a puncture be made with a wire at the point of suspicion, permitting leakage to escape. Another practical method is to insert a pipe nipple through the insulation at each flange joint. Drainage from the nipples will indicate leakage in the line.

Neglected stuffing box leaks will eventually damage valve stems. Most stuffing box leaks can be stopped simply by pulling up the packing bolts, or by tightening the valve gland nut. Be sure to tighten

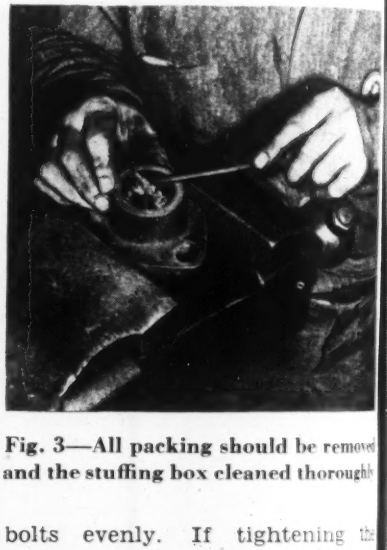

Fig. 3—All packing should be removed and the stuffing box cleaned thoroughly

bolts evenly. If tightening the packing gland does not stop leaking it is a simple matter to replace the packing. To repack, loosen all stuffing box parts and remove the old packing, using a bent wire or other hook to clean the box thoroughly. Insert the new packing and tamp it well into place. Add a few drops of oil between layers to help work in the new material. If ring packing is used, be sure to stagger the ring splits, so that they are not all in line.

Gasket Leaks

If a leak is allowed to continue at a bonnet joint or a flange joint, it

Fig. 4—If the valve has a flat gasket, it should be removed completely and replaced with one of proper material and size

Fig. 5—First step in repairing the valve by refinishing disc and body seat rings is to place the disc in a vise with the seat face up

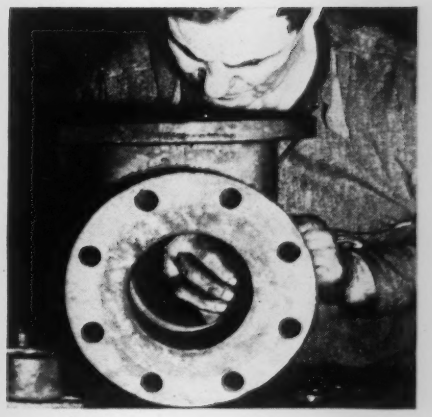

Fig. 6—Use an emery block small enough to permit rubbing of the seat ring surfaces all around

not just the gasket that suffers. The joint faces are soon ruined. If bolt take-up does not cure a joint leak, replace the gasket immediately.

The type of gasket material to be used is important. Variations in gasket materials are so wide that manufacturers' recommendations should be consulted before the material to be used is selected. Various types of gaskets take different treatments before they are inserted in the joints.

Repair of Seat Leaks

If a valve cannot be shut off tightly, the cause of the trouble should be investigated without delay. If a leak is neglected, the seating surfaces may be soon damaged to the extent that replacement of parts or of the complete valve may be necessary.

When a leaky gate valve is discovered, remove the bonnet and examine the disc and body thoroughly to determine the extent of damage to body rings and disc, Fig. 1. If corrosion has caused excessive pitting or eating away of metal, as in the case of guide ribs in body, it may be impractical to attempt repairs. A complete checkup and servicing of all parts of the valve is recommended. Remove the stem from the bonnet and examine it for scoring and pitting where the packing contacts the stem. Light polishing with fine emery cloth is all that may be needed to put the stem in good condition, Fig. 2.

Remove all packing and thoroughly clean the stuffing box, Fig. 3. At the same time, clean the inside of the valve bonnet and other parts to remove all dirt, scale, corrosion, etc., so that the interior of the valve will be free of all foreign particles. If the valve has a flat gasket, it should be removed completely and replaced with one of proper material and size, Fig. 4.

If a ring type joint is used, the oval or octagonal metal ring can be cleaned, and—if not pitted—can be used again. After the cleaning and examining of all parts have been completed, and it is found possible to repair the valve by refinishing disc and body seat rings, or by replacement of body seat rings, proceed as follows:

Place the disc in a vise with seat face up, Fig. 5.

Wrap a piece of fine emery cloth around a flat tool and rub or lap the entire bearing surface (both sides of disc) to a smooth even finish. Remove as little as possible. The usual cuts and scratches found on body seat rings can also be repaired by lapping. Use an emery block small enough to permit rubbing of the seat ring faces all around, Fig. 6.

Work carefully and watch closely. Avoid removal of too much metal to prevent the disc from seating too low. When seating surfaces (discs and body seat rings) seem to be properly lapped, coat the face of the disc with prussian blue and drop the disc into the body to

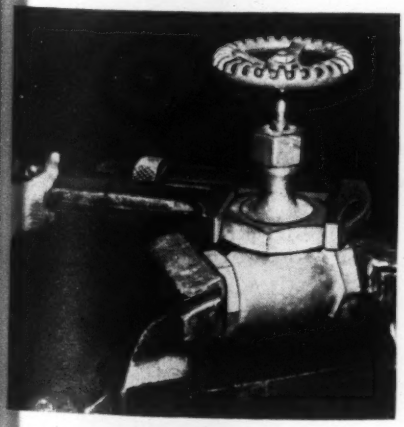

Fig. 7– For regrinding discs and seats in globe valves, hold valve firmly in vise with the stem vertical

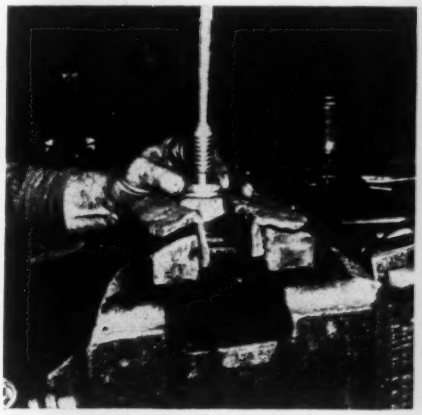

Fig. 8—Remove stem from bonnet, place in vise, and unscrew disc stem ring

Fig. 9—Next, lift out stem and insert a spacer or coin inside of disc

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Fig. 10—Apply an emery-base grinding compound to disc ard seat

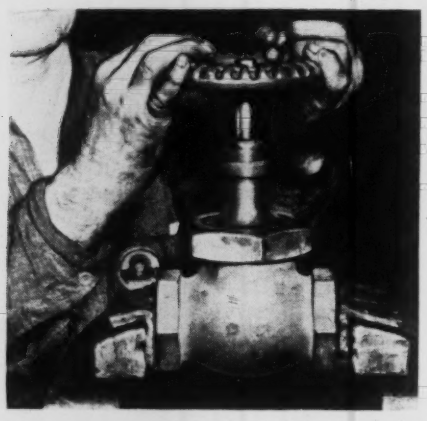

Fig. 11—If valve is a union bonnet design, the union ring should be screwed on, but not tightly

check the bearing. When a good continuous contact is obtained between the disc and body seat ring face, the valve will be tight and is now ready for reassembly.

When assembling, insert the stem in the bonnet. Install new packing. Assemble other parts, including the gland and gland flange, and then attach the disc to the stem. Replace the bonnet gasket, and place the complete assembly in the body. Lift the disc off the body seat ring face so that the bonnet can be properly seated on the body before bolts are tightened. Pull the bonnet bolts up evenly in pairs diametrically opposite each other. Good practice suggests testing the repaired valve before putting back in service. This assures that repairs have been properly made and that the stuffing box is tight.

When body seat rings in gate valves must be replaced, they can be removed and replaced best with a power lathe. Chuck the body with the rings vertical so that the seat faces will be parallel with the face plate. Use a steel bar across the body ring lugs to unscrew them. Removal of rings can be accomplished by hand by means of a cold chisel or hacksaw to split the ring and then collapse it. Extreme caution should be taken so that the ring threads in the body are not damaged. New rings must be pulled up tight against the shoulder on the ring so that leakage will not occur around the body ring. To tighten, place a steel bar across the lugs and pull up with a wrench. Be sure to coat the threads with a good lubricant before inserting the ring into the body. Lap in the same as when repairing a ring, as shown in Fig. 6, for perfect fit to the disc.

Globe and Angle Valves

Repairs on globe and angle valves frequently can be made without removing them from the line. However, it is desirable, when any repairs are needed, to remove the valve from the line for thorough inspection and cleaning. To illustrate the general procedure for regrinding discs and seats in globe valves, a plug type disc valve is used. However, the same method applies to other globe and angle valves except those with composition discs. Procedure is as follows:

Hold the valve firmly in a vise, with the stem vertical, Fig. 7.

Remove the bonnet assembly and examine and clean all parts thoroughly. Remove the stem from the bonnet, place in the vise and unscrew the disc stem ring, Fig. 8.

Lift out the stem and insert a spacer or coin inside of the disc, Fig. 9.

Replace the stem and tighten the disc stem ring. The spacer takes up

Fig. 12—When grinding is completed, clean the disc seat and body of all compound

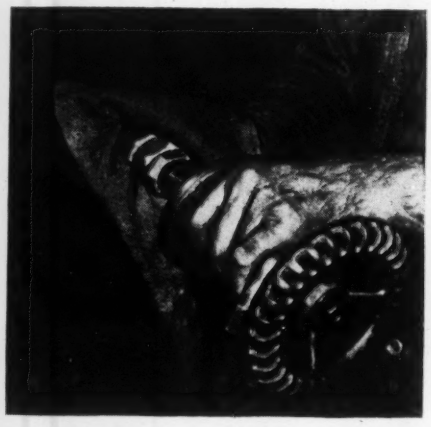

Fig. 13—To replace a composition disc in a globe or angle valve, turn the stem to the fully open position, unscrew the bonnet joint, and lift out the bonnet assembly

the clearance between the disc and the stem. Apply an emery-base grinding compound to both the disc and the seat. A light coating of compound is all that is necessary, Fig. 10.

Place the body and bonnet together. If the valve is a union bonnet design, the union ring should be screwed on, but not tightly—Fig 11. For a bolted bonnet, insert a couple of bolts but do not tighten the bolts. This will provide a guide for the stem.

With a firm hold on the handwheel, apply pressure and oscillate the wheel steadily until all pitting is removed and a continuous smooth bearing on the seating surface is obtained. Grind no more than is necessary for good bearing. When grinding is completed, clean the disc seat and body of all compound, Fig. 12. Use prussian blue to determine if a good bearing has been obtained. The valve can then be reassembled. (Be sure to remove

Fig. 14—Remove the disc retaining nut on the under side of the holder and replace the disc

the spacer from the disc so that it will have free swivel action on the stem.)

When the body seat rings have been damaged beyond repair, they should be replaced. This can be accomplished with a tool specifically designed for the purpose, or by means of a bar fitted into the lugs or slots in the body ring. Before using the valve it is advisable to give it a pressure test to be sure of tightness of the seat and stuffing box.

Composition Discs

Replacing a composition disc in a globe or angle valve as soon as a seat leak is discovered will add much to the valve's life. The procedure is easy.

First turn the stem to fully open position. Unscrew the bonnet joint and lift out the bonnet assembly, Fig. 13. Turn the stem down slightly until the disc holder slips off. Remove the disc retaining nut on the under side of the holder, and replace the disc, Fig. 14. Reassemble the valve.

Where frequent disc changing is necessary, keep a few extra disc holders and discs on hand. Holders can be loaded with discs for various services when convenient. This feature simplifies maintenance and stock problems for composition disc valve parts.

CONSTRUCTION INDUSTRY SHOWS FLEXIBILITY

The far-flung construction industry has demonstrated extreme flexibility and adaptability in adjusting itself to unprecedented changes in both the volume of its work and the nature of the demand since the outbreak of the war, according to Melvin H. Baker, chairman of the Construction Industry Information Committee.

"The industry had to shrink the volume of its work by two-thirds between 1942 and 1945 and then within two years was called on to expand its production more than 100 percent," Mr. Baker pointed out. "The changes, as analyzed by the committee's economists, are measured in terms of 1939 prices.

"Even more violent fluctuations took place in the amount of the different types of construction. Private residential building, for example, declined 58 percent between 1942 and 1945 and then expanded 472 percent, or by almost five times, by 1947.

"Highway construction declined 38 percent in volume and subsequently rose 152 percent, all within the six year period. Private commercial construction gained 17 percent from 1942 to 1945 and made a further sharp gain of 172 percent by 1947. The volume of private industrial construction rose 73 percent and then registered a further increase of 82 percent.

"The most outstanding shifts, as would be expected in a period of transition from war needs to peace needs, were between the general classes of private and public construction. In 1942, in spite of the fact that much private construction was for war purposes, more than three-fourths of the total volume was public construction, of which almost half was done directly for the army or the navy and another third was in publicly financed war plants. By 1947, there was a complete reversal in emphasis, with more than three-fourths of the total going to private construction, while work of directly a military or naval character had shrunk to only 1.4 percent of all new activity.

"During the 1942-1947 period, private residential construction shifted from 11 percent of the total to 37 percent. Private industrial building rose from 2.5 percent to 13 percent and dropped again to 11 percent of all new activity. Utility construction more than doubled its share of the total between 1942 and 1947.

Enormous Problems in Organization

"These figures reveal the extraordinary range and variability of requirements to which the construction industry is subjected and the rapidity with which it must be able to adjust its whole industrial structure—from materials producer to contractor and builder.

"These widespread shifts and variations imposed by the demand involve enormous problems in organization and logistics which call forth the ingenuity of the industry and require a remarkable flexibility which the component parts of the industry have supplied with amazing success."

COPPER TUBE STANDARD AVAILABLE

A simplified practice recommendation for copper and copper alloy round seamless tube has been approved for promulgation, according to an announcement of the National Bureau of Standards. The recommendation will be identified as R235-48, copper and copper alloy round seamless tube, effective from June 15, 1948.

The recommendation was proposed by the Copper & Brass Research Association on behalf of manufacturers of copper tube. Adoption of the preferred sizes listed "should enable the tube mills to schedule longer runs with less frequent resetting of tools; and the repetition of orders for similar sizes should in time permit the building of stocks, and thus regularize production and facilitate distribution."

Until printed copies of R235-48 are available, mimeographed copies of the recommendation may be obtained without charge from the Commodity Standards Div., National Bureau of Standards, Washington 25, D. C.

40 YEARS OF MOTOR PROGRESS CELEBRATED

Forty years of electric motor industry contribution to better living and industrial efficiency was recently celebrated by the motor and generator section of the National Electrical Manufacturers Association at Hot Springs, Va.

The occasion was the 40th anniversary of a 1908 meeting of electric motor manufacturers at the same place, which resulted in the formation of the American Association of Electric Motor Manufacturers, first trade association in the electrical apparatus manufacturing industry, and earliest predecessor of NEMA.

GET HONORARY ENGINEERING DEGREES

Three honorary doctor of engineering degrees were granted last month by the Michigan College of Mining and Technology at the commencement exercises to Walter Geist, president of the Allis-Chalmers Mfg. Co.; Professor R. R. Seeber, retiring head of the department of mechanical engineering at the college; and Leigh Willard, president of the Interlake Iron Co. and Interlake Chemical Co.

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Pittsburgh members were hosts for the 59th annual meeting of the Heating, Piping, and Air Conditioning Contractors National Association

Interest in Pipe Welding Features Contractors' Meeting

Association Continues Work on Procedures

A REPORT on the progress and remaining problems in connection with the development of a satisfactory welding procedure for aluminum piping was one of the highlights of the 59th annual convention of the Heating, Piping, and Air Conditioning Contractors National Association, held at the William Penn hotel, Pittsburgh, last month.

John H. Zink, president, Heat & Power Corp., Baltimore, and chairman of the association's research committee as well as its editorial committee, standard manual on pipe welding, presented a combined report. He indicated that 20 chapters of the new welding manual are now ready for publication but that the material on aluminum welding has had to be completely revised in order to reflect the latest developments. In addition, some research and development work remains to be done before the chapters on aluminum welding can be completed in a form which will be of the greatest help to members.

J. D. Mattimore, chief engineer, product engineering and research, Tube Turns, Inc., Louisville, was asked to tell of the progress and remaining problems in developing a welding procedure for aluminum piping. Very briefly, he pointed out that aluminum and aluminum alloys offer high strength, light weight, good thermal conductivity, resistance to corrosion, passivity when in contact with numerous corrodents, and absence of sparking characteristics. These alloys, he said, are also being recommended for services at temperatures as low as —300 F. For example, in the synthesis of gasoline from natural gas, as in other operations in the chemical fields, large quantities of liquid oxygen are used and aluminum alloys have excellent mechanical properties at this low temperature.

Basically, wrought aluminum pipe falls into two categories; those which are not susceptible to heat treatment but may be work hard-

Newly elected officers of the Heating, Piping, and Air Conditioning Contractors National Association include:

President — Thomas L. Eagan, Washington, D. C.

Vice President—L. L. McConachie, Detroit.

Treasurer—Wray M. Scott, Omaha.

A PROGRESS report on the preparation of the new welding manual, together with a discussion of the remaining and necessary development work in connection with aluminum pipe welding procedures, highlighted the 59th annual meeting of the Heating, Piping, and Air Conditioning Contractors National Association. Other important subjects covered, as reported here, include the now permissible interchange of welders, the revised procedure specifications issued by the association's welding committee, and a report on standardized design methods for radiant panel heating

ened and those which may be heat treated to improve strength. The oxy-hydrogen process and the inert gas-shielded arc welding method are the most commonly used processes in welding aluminum piping. The former, said Mr. Mattimore, requires the use of a flux which is corrosive to aluminum. Inasmuch as the latter method does not require a flux, the investigations he has undertaken in conjunction with the association's research committee have been limited to the inert gas-shielded arc method.

He reported that satisfactory pipe welding procedures have been developed for types 2S and 3S aluminum and that information is now available even though the association's manual is not yet ready for publication. In regard to the alloys such as types 61S and 63S, he advised the contractors not to proceed with welding without contacting the association's welding committee as the procedure has not been settled.

He also advised the members that skill in welding by the inert gas-shielded arc method can be acquired in about two weeks by an operator qualified for steel pipe welding, particularly if the operator is accustomed to handling a separate filler rod. Backing rings, he said, are a great help where permissible, but there are many applications where they cannot be used, such as in food handling. In regard to field welding, he advised that it be eliminated in favor of shop welding wherever possible.

While aluminum is in short supply, Mr. Mattimore felt that the suppliers of this piping material will probably book orders where the application really calls for its use. They will not accept orders, he said, just because other materials are not available.

In closing this discussion, Mr. Zink sounded a warning note by advising the members not to assume they can handle aluminum piping and welding just because an operator in their employ says he can do the work. He urged the contractors to get in touch with the committee and to get all possible help in regard to welding procedures.

Steel Flanges Tested

Mr. Zink then outlined the work done by the research committee in cyclic testing steel flanges, at the request of the American Society of Mechanical Engineers. These tests, which are almost completed, were undertaken for the purpose of evaluating the relative merits of present flanges and the necessary limitations of flange design in the higher pressure and temperature ranges.

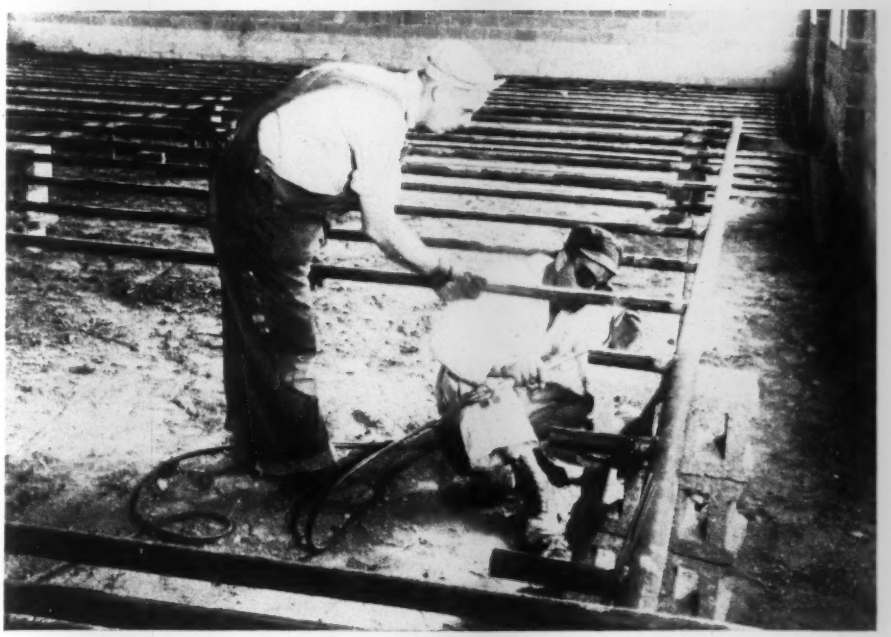
He reported that in running destructive tests to find the value of the flange in relation to the pipe, in some cases, where poor threading was used, the strength of the flange (at the threads) was as low as 6 percent of the strength of the pipe. Welding neck flanges, he said, are the strongest and while these are higher in first cost, they are cheaper to weld than the slip-on flange.

Qualified Welders Can Now Be Interchanged

Until recently, the provisions of the ASME Boiler Code were such that tests conducted by one manufacturer did not qualify a welding operator to do work for any other manufacturer. The report of the National Certified Pipe Welding Bureau, given by W. W. Murray, Jr., Almirall & Co., Inc., New York City, chairman of the board of trustees of the bureau, called attention to an important change which is the result of several years' effort by the bureau, the boiler code committee, and the National Board of Boiler and Pressure Vessel Inspectors.

The ASME Boiler Code has been revised to recognize the transferring of welders from employer to employer and from job to job for the welding of piping, not a part of the boiler circulation and beyond the outlets of the boiler, *provided a standard procedure is used*, he said. Inasmuch as these amendments avoid duplication of qualification tests of procedures and welding operators, Mr. Murray felt that they clear the way for the bureau to adopt a constructive program, and

The association has recently revised its standard procedure specifications for welding wrought iron, steel, and carbon molybdenum pipe, fittings, and flanges



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he urged members of the association to join local chapters of the bureau, or if there are none in the district, to apply for a charter.

Members Get New Welding Specifications

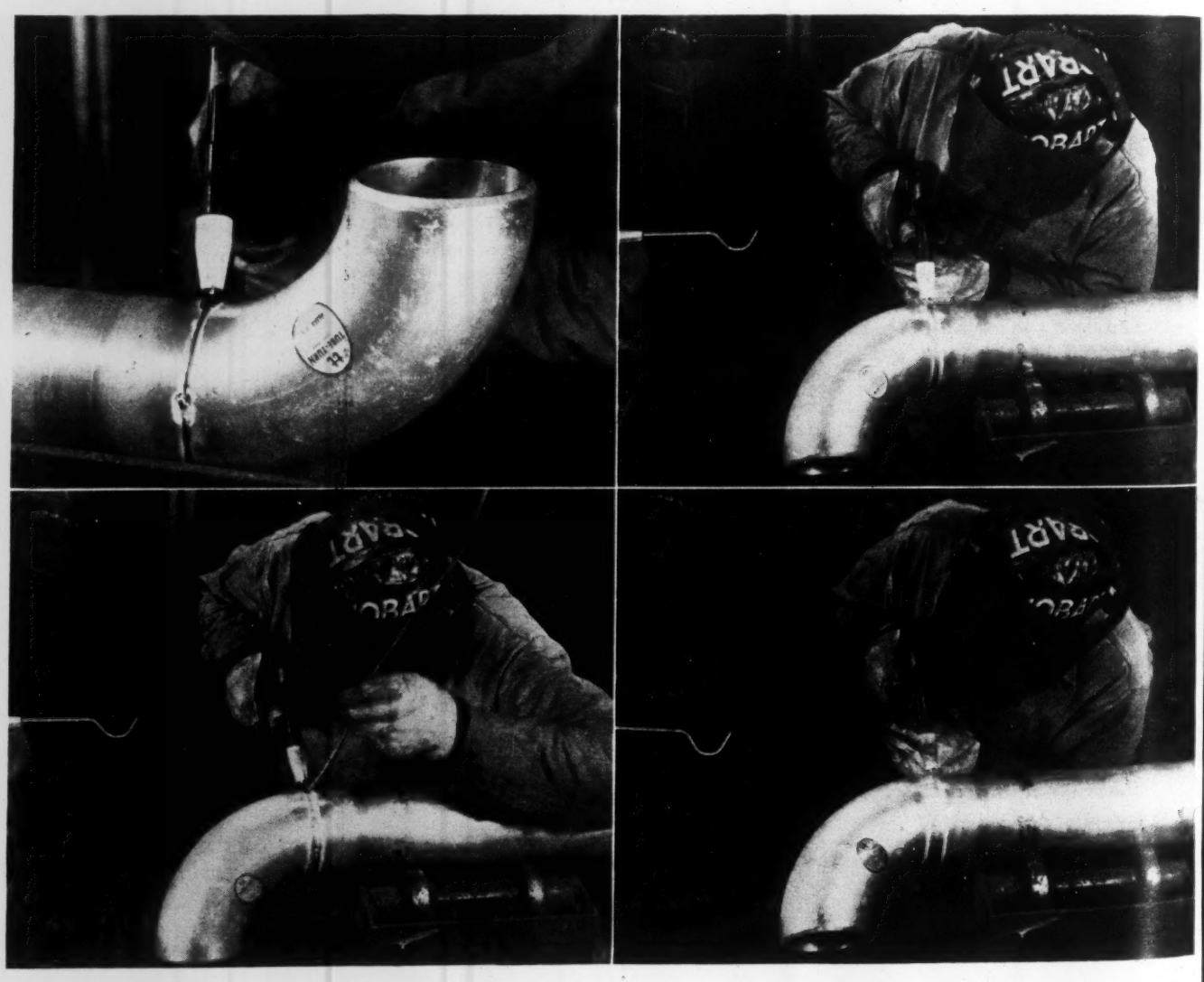
During the past few years, the welding procedure specifications adopted by the HPACCNA have been out of print and members have been using the procedure specifications of the National Certified Pipe Welding Bureau. Inasmuch as the bureau was set up to facilitate the certification of procedures and welding operators, and since there are many association members who do not belong to the bureau, some confusion resulted.

For example, there have been instances where inspectors have been skeptical about the use of the bureau's specifications by parties not members of the bureau. At the 1947 convention of the association, this matter was the subject of considerable discussion and the welding committee agreed to revise the specifications of the national association. This has been done, and in his committee report Chairman R. S. Tobin, Power Piping Corp., Cambridge, Mass., said that the recommended procedure applies to metallic arc welding and oxyacetylene welding of wrought iron and steel pipe, fittings, and flanges as well as for metallic arc welding of carbon molybdenum steel pipe, fittings, and flanges.

It was strongly recommended that members adopt the procedures and qualify them for their own use. However, contractors who wish to have a qualified procedure and qualified operators but who are reluctant to make the necessary investment may join or form a local chapter of the National Certified Pipe Welding Bureau.

Copies of the newly revised procedure specifications were distributed and Mr. Tobin stated that they are essentially identical to those of the bureau and would be revised slightly to make them in closer agreement.

He called attention to the practice, in some shops, of using welding operators, who had previously demonstrated their ability in a qualified shop, to do welding for which the shops are not qualified. In some cases, he said, inspectors will pass the work on the strength of the operator's reputation. This practice subordinates the shop to the welding operator and should not be tolerated.



Here are the four steps used in welding a type 3S aluminum alloy pipe (half hard) and elbow (annealed). Top left—Tacking is the first operation. Top right—The first pass is accomplished without the use of filler metal, the heat of the arc being used to fuse the ends together. Bottom left—The deposition of the second pass requires the use of a filler wire of 2S aluminum alloy. Bottom right—The completion of the cover bead is accomplished by using the inert gas-shielded arc torch without filler metal. In order to show the technique more clearly, these photos were taken without current actually flowing between the work and the torch

Design Standardization Major Panel Heating Problem

In reporting on the second year of existence of the radiant panel heating committee, Chairman P. B. Gordon of Wolff & Munier, Inc., New York City, stated that the more important problems this year are the same as those of last year, particularly the problem of standardization of design data for radiant panel heating installations.

The research program of the American Society of Heating and Ventilating Engineers was briefly outlined by Mr. Gordon, who indicated the scope of each of its four sub-committees. He said that the major portion of the first year's budget of $100,000 will have to come from the entire industry as ASHVE funds will take care of only 20 percent of this amount. He stressed the fact that the HPACCNA will participate to a major extent in the technical benefits resulting from the extensive research on radiant panel systems.

"It is hoped," he said, "that within the next year or two specific results will be forthcoming that will permit standardization of design techniques in which the data and performance values used are industry wide standardized values which can be backed up by controlled research reports and tests."

Announces Winners of Performance Study

A contest to stimulate the interest of engineering students in radiant panel heating and to make available to the committee performance data covering the actual operation of such systems was recently concluded. Mr. Gordon announced that the first prize was won by Erik Erichsen and James M. Kane, senior students at the Case Institute of Technology, for their joint paper which presented factual information—including thousands of thermocouple temperature readings on maintained water temperatures, panel temperatures, panel outputs, load requirements, etc. Messrs. Kane and Erichsen, the latter an exchange student from Norway, together with Mrs. Erichsen, were present and received the prize and congratulations of the members.

S. H. Givelber, Reliance Heating and Air Conditioning Co., Cleveland, was accorded the thanks of the association for making available to the winning contestants a radiant panel installation. When called to the microphone, he briefly described the installation and told of the outstanding scholastic work of these two young men, giving some interesting sidelights on the sacrifices which the Erichsens have made in order to secure a technical education in this country.

The second prize was won by James M. Ayres, graduate student, University of California. The judges were Prof. M. C. Giannini, assistant dean and associate professor of mechanical engineering, New York University; W. E. Heibel, district manager, Aerofin Corp., New York City, and D. L. Mills, research and development engineer, Revere Copper and Brass, Inc., Rome, N. Y.

Resilient Floor Coverings Can Be Used

Since the report made by the committee last year, several technical reports have substantiated the recommendation that resilient floor coverings may be installed over radiant heated subfloors. According to Mr. Gordon, the results showed that effects of various systems on the hardness, composition, and indentation properties were such that specific manufacturers' recommendations permit the proper application of such floor coverings over heated panels without fear of difficulty.

During the past year the radiant panel heating committee and the association's committee on certification were requested by the Secretaries' Conference for an outline that would permit the various local associations to certify radiant panel heating installations. After consultation between the two committees, a method was prepared and was released to the local associations. The outline takes into consideration the data already available as part of the national association's publications and outlines in step-by-step form the various checks to be made.

A concluding report on other activities of the HPACCNA meeting will be published in a forthcoming issue of HPAC.

STAINLESS STEEL HAS PERMANENT EXHIBIT

Stainless steel production in the United States has increased from 42,000 tons in 1929 to over 500,000 tons last year, George S. Rose, secretary of the American Iron and Steel Institute, told steel men and press representatives who attended a preview of a permanent stainless steel industry exhibit in the Architects' Samples building, 101 Park Ave., New York City.

"The term 'stainless steel' denotes a large family, a group of some 30 alloy steels which resemble each other yet differ widely in characteristics and use," Mr. Rose said. "The family resemblance is based on the fact that all stainless steels contain chromium in addition to the iron and carbon present in all steels. It is the chromium in this combination that makes the steel stainless. Nickel is an important component of many grades."

AISI types of stainless steels

Type Number	Chromium	Nickel	Other Elements
301	16.00/18.00	6.00/8.00	——
302	17.00/19.00	8.00/10.00	——
302B	17.00/19.00	8.00/10.00	——
303	17.00/19.00	8.00/10.00	P, S, Se Min. 0.07, Zr, Mo Max. 0.60
304	18.00/20.00	8.00/11.00	——
308	19.00/21.00	10.00/12.00	——
309	22.00/24.00	12.00/15.00	——
310	24.00/26.00	19.00/22.00	Mo 1.75/2.75
316	16.00/18.00	10.00/14.00	Ti 5 x C Min.
321	17.00/19.00	8.00/11.00	Cb 10 x C Min.
347	17.00/19.00	9.00/12.00	Turbine Quality
403	11.50/13.00	—	Al 0.10/0.30
405	11.50/13.50	—	Al 3.50/4.50
406	12.00/14.00	—	——
410	11.50/13.50	—	——
414	11.40/13.50	1.25/2.50	P, S, Se Min. 0.07, Zr, Mo Max. 0.60
416	12.00/14.00	—	——
420	12.00/14.00	—	——
430	14.00/18.00	—	P, S, Se Min. 0.07, Zr, Mo Max. 0.60
430F	14.00/18.00	—	——
431	15.00/17.00	1.25/2.50	Mo 0.75 Max.
440A	16.00/18.00	—	Mo 0.75 Max.
440B	16.00/18.00	—	Mo 0.75 Max.
440C	16.00/18.00	—	——
442	18.00/23.00	—	0.90/1.25 Cu
443	18.00/23.00	—	N_2 0.25 Max.
446	23.00/27.00	—	

How to Select the Right

COMBUSTION CONTROL

FRED MEYER, combustion engineer, Mid-West Heat Service, Chicago, describes clearly and briefly the fundamentals of various types of combustion control systems for boiler installations in plants and buildings. He then explains the principles—including the economics—of the proper selection of such control for various applications. His article in June covered fuel selection; both these subjects were discussed by Mr. Meyer at a recent meeting on planning sponsored by the American Hospital Association

LET US EXAMINE the problem of fuel conservation. It is a truism that every operator would like to obtain the greatest efficiency from his equipment, and thus maintain the lowest possible cost; but it is equally true that few are accomplishing this ideal. The most important reason for failure to obtain maximum efficiency might be lack of proper control and instruments.

Proper selection of instruments and controls becomes a function of the quantity of fuel to be consumed. It is evident that in order for the equipment selected to amortize itself in a reasonable time, the maximum outlay for instrumentation and control is dependent on the fuel savings which may be effected by its use.

No discussion of combustion control would be complete without a discussion on CO_2, excess air, and stack temperature. It is assumed that the basic relationships between these three need not be repeated here, but that a brief summary will suffice. The relationship between high CO_2 (low excess air) and low stack temperature is the ultimate aim we desire to accomplish. It is important that we evaluate the cost of obtaining these features with combustion control as against the loss encountered by the lack of its use.

Two Classes of Combustion Control

Combustion controls may be divided into two general classes—positioning and metering. To understand the essential difference between the two, let us examine what we are trying to accomplish.

In a simple positioning system, we control fuel feed from steam pressure by means of some master device and adjust the air in ratio with the fuel as fed. The simplest case is the fully automatic, one speed, burning device. In this case, the air flow is set at a constant level, usually by means of the uptake damper, which is at a fixed position. The fuel is fed at a constant speed and is either on or off from pressure demand. It is obvious that usually this is not an economical method of firing on larger installations, due to the fact that a constant overshooting and undershooting of steam pressure occurs. In order to minimize the starts and stops, a method for varying the fuel feed is introduced.

It follows that the amount of air necessary for proper and efficient combustion must be varied also. A simple device would be a motorized controller, or a piston, actuated by steam pressure connected to the fuel feed by means of a lever arm and an extension to the uptake damper, which raises or lowers it as the fuel feed is increased or decreased. A further refinement might be obtained by adding the automatic feature of shutting off the equipment should the lowest position of firing still feed more fuel than the system requires. A further modification could then be added that the uptake damper could automatically be shut when the firing equipment is in the off position. This is a typical modulating automatic type of positioning controller.

Such a controller is set by adjusting the damper position at high fire to provide the highest CO_2 obtainable and again adjusting to obtain the highest CO_2 on low fire. The difficulty lies in the fact that neither the fuel feed nor the air flow follows a straight line curve when compared

to the angle of position of the levers controlling their operation.

For example, the usual uptake damper is a rectangular steel plate in the boiler uptake mounted on a steel rod at its midpoint, the steel rod projecting at a right angle through the breeching. The damper is rotated by the rod from open to closed position. When the damper is wide open the rod has been rotated 90 deg. A position of half opening, or 45 deg, does not necessarily mean that only half as much air will flow past the damper opening, and yet this is the supposition that we make in this type of control.

By the same token, the fuel feed may be applied by a variable speed drive or a V-notch port valve (in the case of oil) or a butterfly valve (in the case of gas). In no instance are we assured that the amount of fuel flowing past the control point is directly proportional to the angle of repose of the lever arm actuated by the controller—and, actually, it is not. The only point of which we are sure is that at the maximum and at the minimum settings—the points at which we made our CO_2 checks—we have effected a certain set of conditions. At all other points throughout the range, we may expect (and we will obtain) variations from these settings. It would be possible, by means of a specially designed cam, to arrange the positioning of the uptake damper to match the fuel feed at more than two points, but again we have only an approximate evaluation of the ratio of fuel to air.

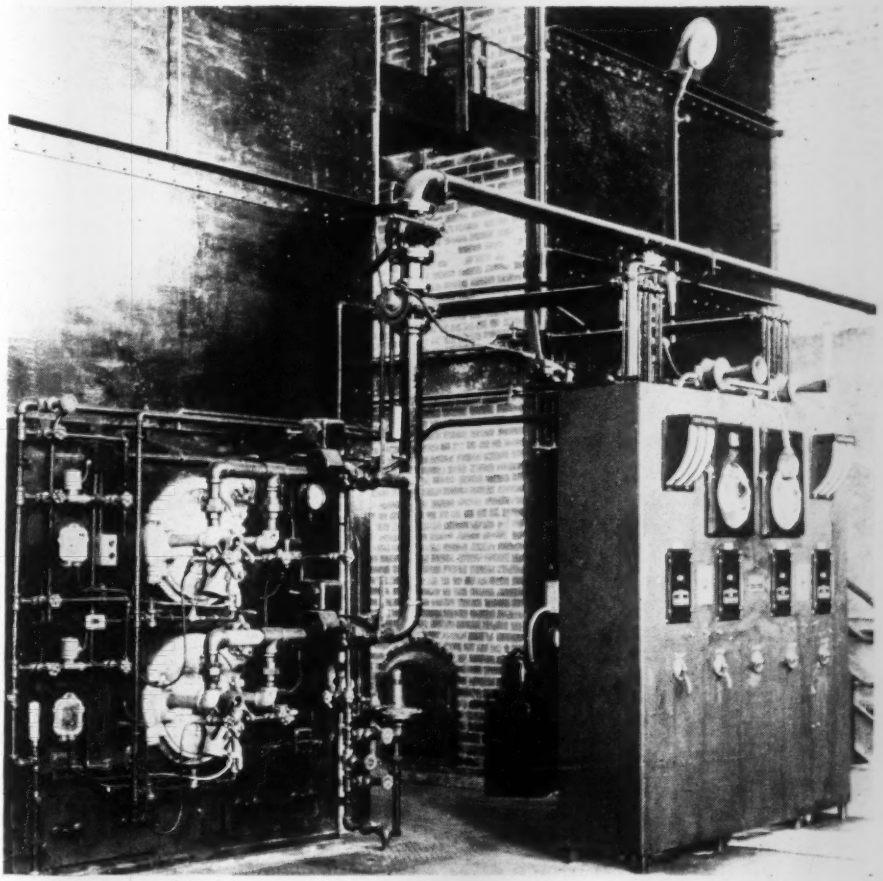
Using a Metering Control

In using metering control, we meter the amount of air used for a given amount of fuel. In order to understand better how this is accomplished, we must go back to fundamental hydraulics and consider the formula:

$$W = \sqrt{2gh}$$

where W is the weight, g is the gravity constant, and h is the head.

This formula expresses the flow of a gas through an orifice. If we consider the boiler as a pipe, and the tubes or baffles as an orifice through which the gases flow, and if we measure the pressure drop through the boiler from one position to another, we know that we have passed a definite volume of gases past these points to the uptake; for any given pressure drop through the boiler, we have established a corresponding rate of flow of the products of combustion.



Two 310 hp water tube boilers fired with combination gas and oil burners, showing installation of panel with steam flow. air flow meters and metering control

In actual practice with metering control, we do not measure the air entry—generally speaking—but instead measure the products of combustion. There is no appreciable difference, however, in measuring products of combustion instead of air. There is, of course, the difference of temperature, which occurs from entering air to products of combustion at the stack uptake. It is the basic fact that the volumes of entering air and products of combustion are the same that makes metering control possible. The differential in volume due to temperature changes is compensated for on setting up the equipment in test methods, which will be described later.

We have discussed the basic principle that pressure drop past a given orifice measures the flow of gas past that orifice, and that by measuring products of combustion we are in effect measuring the volume of entering air, due to the fact that these volumes are the same; and that compensation for temperature differential may be made by setting up equipment on test. Now let us take a concrete example of a metering combustion control system so that we may follow this operation through the various stages necessary to accomplish this purpose.

Consider the case of a typical water tube boiler fired with a spreader stoker. In order to control the fuel feed, we would employ a master controller actuated from steam pressure. This controller would be connected to the fuel feed mechanism of the stoker and would feed more or less fuel on steam demand.

The air flow entering the boiler from a forced draft fan would be controlled by means of a differential controller operated from the master controller and linked to the forced draft fan. As the master controller changes its position, this change in position is transmitted to the differential controller, which sets up a pressure differential between the first and the last passes on the boiler, thus establishing the rate of flow of the products of combustion. This position is transmit-

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ted to the forced draft fan, which sends larger or smaller amounts of air into the fire box as demanded by the differential controller.

The system would be completed with the use of a controller maintaining constant overfire draft by means of the uptake damper.

This is perhaps the simplest type of metering control, and is adaptable for coal, oil, or gas—but is better suited to the latter two fuels for the reason that should the Btu content of the fuel vary, this system does not take this variable into account. The pistons which motivate the fuel feed, forced draft fan, and uptake damper may be powered in this type of control with either compressed air, water, or oil. For the system described, oil is most generally used, furnished through an oil pumping unit complete with an oil reservoir.

The operation of the differential controller, which is activated from the master controller, uses the principle of a spring loaded diaphragm connected to the upstream and the downstream sides of the orifice plate (which in this case is the boiler baffle), thus measuring the air flow. As the lever arm shifts the spring position, a new tension is placed upon the diaphragms, which must be balanced by a series of inlet oil valves, which in turn move the position of the piston, which operates the forced draft fan. The system, when balanced, produces the proper pressure drop across the orifice.

Adjusting a Metering Control

In adjusting this type of system, the boiler is fired to the steam pressure desired by means of manual control, and the adjustment of the forced draft fan is made to give the highest CO_2 obtainable for this particular rate of firing. Adjustment is simultaneously made of the overfire draft controller. When this has been accomplished, the combustion control is set to maintain this CO_2 at the position selected. The equipment is then made to operate at various other selected points throughout the range and similar adjustments are made at these points. It will be noted that this method of testing and adjustment takes into account the differences in temperature between entering air and products of combustion previously mentioned.

CO_2 Can Be Too High

It is important to recognize the fact that CO_2 readings can be too high for proper life of the refractory brickwork. This is particularly true at high ratings of the boiler. If the refractory brickwork and combustion volume in a boiler have been properly designed, deterioration of the fire brick or plastic will not occur unless the CO_2 readings are excessively high. For this reason, most well operated plants taper off on CO_2 slightly as they approach top rating.

In the type of combustion control just described, no compensation is made for any variation in Btu content of the fuel. This variation is likely to occur when using coal but is of no practical consequence with oil or gas. It is possible to obtain coals from the same region that vary as much as 2000 Btu per lb, or a difference of approximately 20 percent. In the case of fuel oil, a particular bunker C oil may have a Btu content of 152,500 per gal whereas another one will have 151,000 Btu per gal; this is a difference of less than 1 percent. In the case of gas, variations are smaller than this, because by its nature gas coming from the same field is usually very homogeneous.

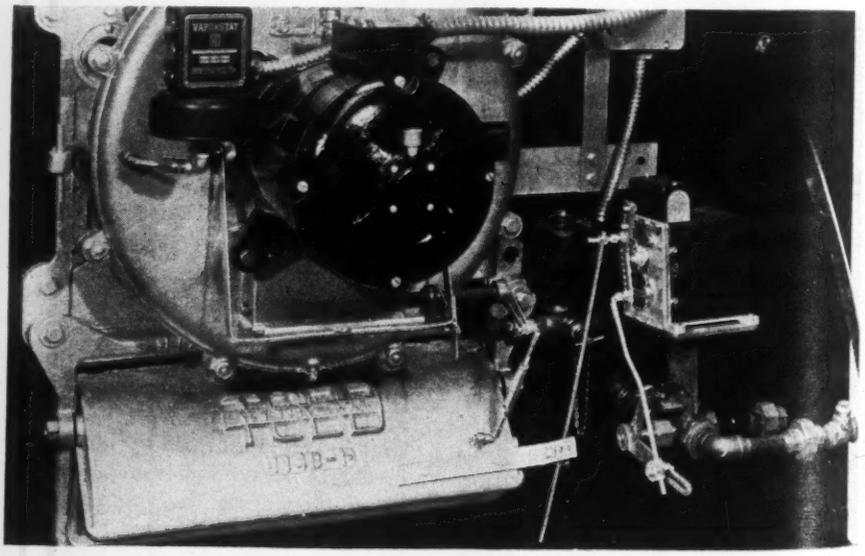
If we were to plot on ordinary graph paper the pounds of air for theoretical combustion against the pounds of air required per 10,000 Btu of steam generated, we would be confronted with a startling fact—in all cases, irrespective of the type of fuel used, our curve would be a straight line. Not only would we find that our curve is a straight line, but we would find that it is a horizontal straight line, and that 7.5 lb of air would be required for each 10,000 Btu of steam generated.

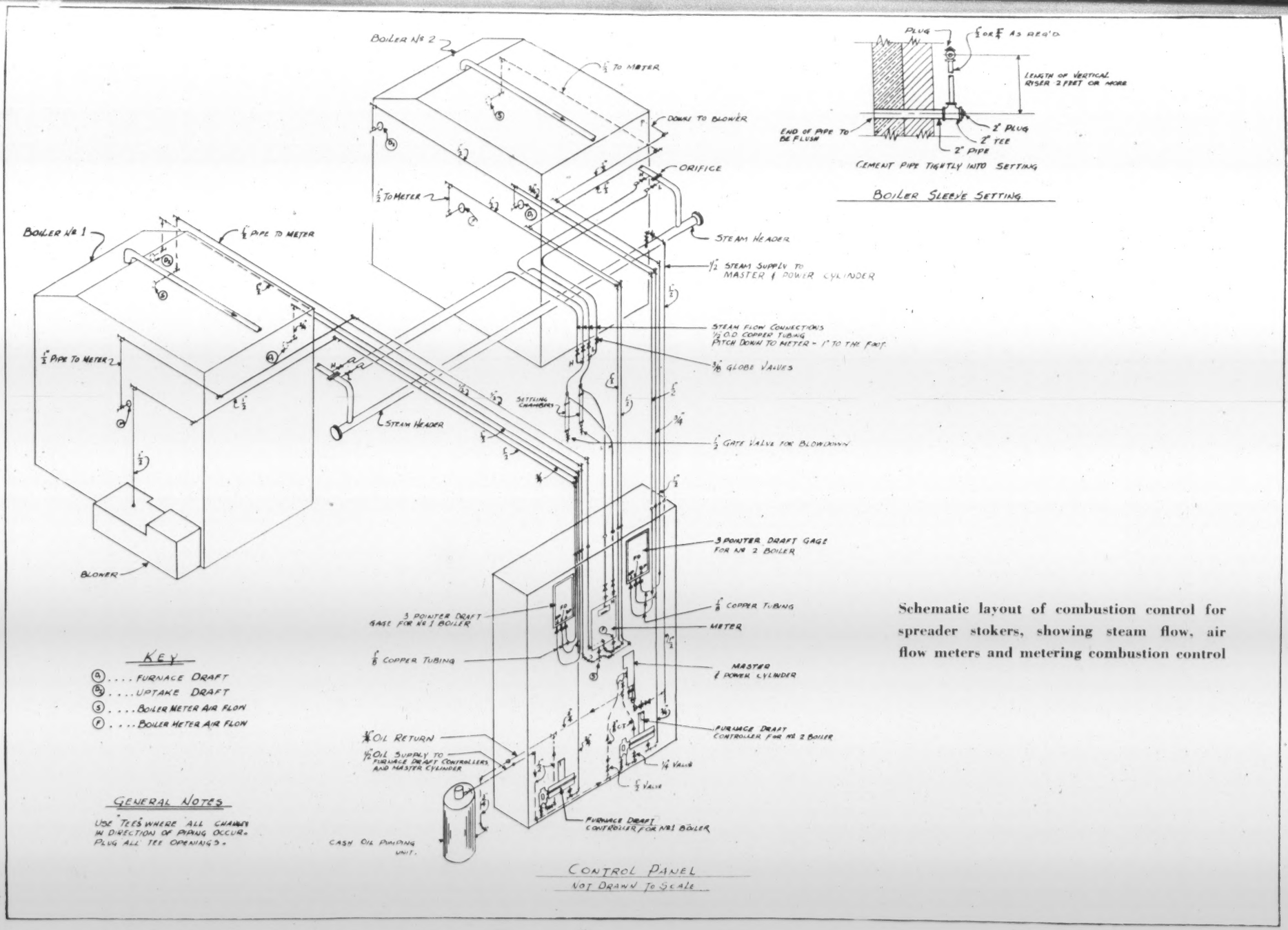
Correlating Steam and Air Flow

In actual practice, it is evident that if we were to compare pounds of air used for combustion and pounds of steam evaporated, we could accurately measure one as against the other. This is the basis for a system of combustion control which employs the steam flow as against the air flow in metered amounts and takes into account necessary readjustments for variations in the Btu content of fuels. In this system of combustion control, in which steam flow and air flow are correlated, the heart of the system is a steam flow meter upon which is recorded the steam flow in thousands of pounds per hour as against the air flow in pounds per hour. It follows that, if by test, the positions of the two pens are so related to each other as to coincide when the best actual conditions for combustion occur, we should be operating at the highest possible efficiencies.

Such a system includes the master controller, which measures the steam as it passes through the boiler header by means of an orifice. By measuring the pressure drop across the orifice, we have determined the actual amount of steam flowing past

An oil burner, showing linkage for simple positioning control. The primary and secondary air and oil are all controlled in direct ratio, one with the others




BOILER № 2
BOILER № 1
½" TO METER
DOWN TO BLOWER
ORIFICE
½" TO METER
½" PIPE TO METER
STEAM HEADER
½" STEAM SUPPLY TO MASTER ℓ POWER CYLINDER
STEAM FLOW CONNECTIONS ½ O.D. COPPER TUBING PITCH DOWN TO METER - 1" TO THE FOOT
⅜ GLOBE VALVES
SETTLING CHAMBERS
¾"
½" GATE VALVE FOR BLOWDOWN
½" PIPE TO METER
STEAM HEADER
BLOWER
3 POINTER DRAFT GAGE FOR № 2 BOILER
⅛" COPPER TUBING
METER
3 POINTER DRAFT GAGE FOR № 1 BOILER
⅛" COPPER TUBING
MASTER ℓ POWER CYLINDER
FURNACE DRAFT CONTROLLER FOR № 2 BOILER
¼" OIL RETURN
½" OIL SUPPLY TO FURNACE DRAFT CONTROLLERS AND MASTER CYLINDER
¼" VALVE
½" VALVE
FURNACE DRAFT CONTROLLER FOR № 1 BOILER
CASH OIL PIPING UNIT.
KEY
Ⓐ . . . . FURNACE DRAFT
Ⓐ₂ . . . . UPTAKE DRAFT
Ⓢ . . . . BOILER METER AIR FLOW
Ⓕ . . . . BOILER METER AIR FLOW
GENERAL NOTES
USE TEES WHERE ALL CHANGES IN DIRECTION OF PIPING OCCUR. PLUG ALL TEE OPENINGS.
CONTROL PANEL
NOT DRAWN TO SCALE
PLUG
½" OR ¾" AS REQ'D
LENGTH OF VERTICAL RISER 2 FEET OR MORE
END OF PIPE TO BE FLUSH
2" PLUG
2" TEE
2" PIPE
CEMENT PIPE TIGHTLY INTO SETTING
BOILER SLEEVE SETTING

Schematic layout of combustion control for spreader stokers, showing steam flow, air flow meters and metering combustion control

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the orifice at any particular time. By using the boiler as an orifice, as already described, we have measured the actual amount of air passing this orifice so that we have established a basis for comparing one to the other. It remains to hold our steam pressure constant by varying the amounts of fuel required, and then relating the amount of air required for this given amount of fuel so that the proper relationship is maintained at all times.

In practice, this is accomplished by the use of a master controller, which feeds more or less fuel upon steam demand. This master controller simultaneously feeds more or less air as required.

Let us now assume that the two pens—steam flow and air flow—do not coincide on the meter.. At this point, the readjusting controller in the boiler meter takes charge of our situation. A pilot valve is connected by linkage so that it is actuated only when the motions of the steam flow pen and the air flow pen are not of equal amounts. As long as the records coincide and do not separate, best combustion conditions prevail and the pilot valve remains in its natural position.

Should the air flow record rise above the steam flow record, indicating too much excess air, the steam flow, air flow pilot valve would be moved slightly, thus transmitting an impulse to the air controller, which immediately readjusts the air flow to bring the two pens together—at which time the system is in balance. The air has been controlled in this system from the furnace draft controller. The forced fan draft operation obviously depends on the furnace draft controller, which regulates the operation of the forced draft fan by means of inlet vanes or a damper arrangement.

In the system described, the steam flow, air flow combustion control has been operated with fuels burned in suspension. Were we to consider a chain grate stoker or an underfeed stoker installation, it is obvious that the quantity of air through the fuel bed would determine our steaming rate rather than the amount of fuel fed. In actual practice, this is the method of control used on this type of installation.

The equipment is put into operation by actual test adjustment at various points throughout the entire firing range. Various CO_2 samples are obtained, the stack temperature is measured at various operating points, and the best operation for each point is selected by manual methods. The combustion control is then set to these various test points and checks are made at random points to determine the accuracy of the setting already established. It is again important to note that CO_2 is not held constant throughout the entire range but rather is made to taper off as high ratings are approached. This statement is not always true, however; it is possible with water wall furnaces, where quick cooling of the refractory is obtained, to maintain high CO_2 throughout the entire range of operation.

Other situations exist that may require various settings of CO_2. For example, on water wall furnaces employing pulverized coal, at extremely low ratings the furnace temperature may be so low that smoking may result. In this event, the proper solution may be to increase the amount of excess air slightly so as to obtain better combustion. This is just another advantage of using proper combustion control.

Fuel Flow, Air Flow Applications

The application of air flow control is very wide and it is well suited to large installations. There are, however, exceptions in which steam flow, air flow control may be replaced by a control method which is better adapted to the fuel to be used. This is particularly true when gas is the fuel. In the event that we have wide variations in load, it is in some cases more advantageous to use fuel flow, air flow rather than steam flow, air flow.

Consider, for example, an installation in which loads vary widely on a water tube boiler which is fired with combination gas-oil. We are operating the plant on gas and we approach the top limit of the capacity of the forced draft fan. At this point the system demands more steam than the capability of the fan to furnish air. The master controller begins to feed more gas to the system but there is no more air available. The added amount of gas begins to reduce the excess air to a point where the air can no longer support the combustion of the fuel fed. At this time, we begin to form CO and inasmuch as we are not receiving the full Btu value of the fuel, our steam pressure begins to drop. The master controller now feeds more fuel and we proceed to become more and more involved in a difficult situation. The air flow control unfortunately is measuring raw gas so that it no longer is an actual meter of the conditions as they are.

In situations of this type, a more positive method would be the control of the fuel itself rather than the control of steam flow. In installations of this sort, an orifice is placed in the gas line and the pressure drop of the gas past the orifice is used as the correlative between steam flow and air flow. If gas were the only fuel employed, this method would show distinct advantages over the steam flow, air flow method of control. Where gas and oil, or gas and coal, or all three fuels are employed, it is possible to use a combination control of steam flow, air flow and fuel flow, air flow to accomplish the desired results.

Instruments Tell What Is Happening

It is necessary for any well equipped boiler installation to have sufficient instruments so that the operating engineer can at all times have a sound concept of what is occurring in his plant. It is quite obvious that good combustion control is essential in the operation of a plant, but the engineer has no idea of what is occurring in the plant, or whether or not his combustion control is functioning, unless he has sufficient instrumentation to act at least as a temporary check.

The most important of these instruments is a draft gage. The proper use of a draft gage will provide the engineer with a method for checking at all times the draft conditions in his boiler. Depending upon the type of firing equipment in service, a draft gage might be a one point or a multipoint type, the latter giving various draft conditions at various points in the boiler system.

Another quick method for testing the operation of a plant is offered by a flue gas temperature recorder.

By its use, the operator can tell immediately whether or not his combustion efficiency approaches the expected rate. Should the flue gas temperature be excessive, the operator is warned at once that a situation is occurring in his boiler which is not normal. This is also a good check as to whether his boiler is clean, or whether scale might be forming, or slag, or soot on the various tubes or passes of the boiler surfaces. This would also warn him that baffles were not functioning properly.

A steam flow meter is another instrument which is very valuable in any boiler plant. By relating the amount of steam used to the amount of fuel consumed, the operator has a reasonable method for checking performance of his equipment. In the event that a system of combustion control is used which does not require the use of a steam flow, air flow meter as part of its basic equipment, the operator could use such a meter as a constant check on his combustion efficiency. If the steam flow, air flow pens are not operating together at all times, the operator would know at once that he is out of step as far as combustion efficiency is concerned.

Some engineers prefer the use of a CO_2 recorder. I do not take issue on this matter of preference but believe that a steam flow, air flow meter not only answers the question of efficiency but actually answers an accounting problem of the amount of steam used at any time. There is too, the matter of maintenance of the two pieces of equipment.

The well integrated and organized boiler room must be maintained with utmost care. If the instrumentation and combustion control are scattered, it is difficult for the operator to check properly the various instruments at the times required. If these instruments are mounted on a panel board, so located that from proper points of vantage the operator can see all major operations of his plant at one time, a great saving in labor and a better operating plant results.

Combustion Control Selection a Question of Economics

Various methods of combustion control have been discussed and various instrumentation has been recommended. The designing engineer is faced with the problem of the proper selection of equipment to match the fuel burning equipment already selected. It has previously been shown that economics plays an all important part in the selection of combustion control and instrumentation in any plant. It is incumbent upon the designing engineer to investigate the amounts of fuel to be consumed by the equipment and compare the amounts of fuel with the cost of various instruments and combustion control that he may believe best suited to the plant.

A simple method of setting up such a comparative value would be to estimate the total cost in dollars per year of fuel to be consumed. The next step would be to determine the cost of the cheapest control which would give the operator the results desired in the way of operating his plant. When this selection has been made, the relative efficiency of one type of control as compared to the next better type of control should be investigated.

In order to do this, it would be necessary for the designing engineer to estimate the relative overall efficiencies between the two methods of control being compared. For example, if the fuel consumed in a plant costs $15,000 a year, and the cost of simple positioning control would be an item of $700, whereas the cost of simple metering control would be a matter of $1900, an increased capital investment of $1200 would be required were metering control employed. The designer would perhaps estimate that an additional saving of 3 percent might be made by using a simple type of metering control, which would mean a saving of $450 in fuel consumption. The increased cost of one control over the other ($1200) must be weighed against the $450 saving which might be made by the use of better combustion control. In this particular instance, the saving would pay for the better control in a period less than three years, so in all probability the engineer would select a metering rather than a positioning type of combustion control.

If the fuel consumption in the plant were an item of $50,000 annually, then the use of a still more refined control of the repositioning type—such as steam flow, air flow or fuel flow, air flow as against a simple metering control—might be considered. In this case, approximately $5000 might be the cost of this type of control as against $1900 for the simple metering control. Further, the designing engineer might decide that the additional saving to be made would be 2 percent over the simple metering control, or $1000. The $1000 saving would then be compared to the $3100 initial increased capital investment and the designing engineer would probably feel that he was justified in placing repositioning metering control into the installation.

The information presented here is intended to offer a guide in the proper selection of instrumentation and combustion control for any particular installation. Other problems may affect this selection, such as future increase of load in a plant or the possibility that the type of fuel being used may be changed at a later date. For many reasons, therefore, the selection of this equipment should be given due and careful consideration so that the best possible results may be obtained from the boiler and firing equipment.

Control selection chart that summarizes author's observations*

COST OF FUEL ANNUALLY	TYPE OF CONTROL	SAVINGS AS AGAINST MANUAL OPERATION	COST OF CONTROL
$0 — 13,000	Positioning	10%	$ 700
$13,000— 50,000	Simple metering	10% + 3%	$1900
$50,000—100,000	Readjusting metering	10% + 3% + 2%	$5000

*The assumption has been made that the installation is average, with a variable load. Return of capital investment to be made in three years or less.

SBI MARKS 20TH ANNIVERSARY

Fifty representatives from 30 different companies and organizations attended the 20th anniversary meeting of the Steel Boiler Institute at Hershey, Pa.

Headed by R. A. Locke, president and manager, the institute met to discuss trends in the steel boiler industry and to elect directors. Newly elected to the board is E. I. Boardman, vice president, Spencer Heater Div., Avco Mfg. Corp.

District Heating Industry Enjoys a Substantial Increase in Steam Sales

John F. Collins, Jr., Secretary-Treasurer of NDHA, Reports on Trends in Industry

At the 39th annual meeting of the National District Heating Association, held recently in St. Louis, the retiring president, Robert D. Martin, assistant vice president and manager of sales of the New York Steam Corp., said in his address that district heating has achieved a substantial load growth in the past 10 years of approximately 50 percent, based on total sendout. The industry appears to be unusually healthy and vigorous, he stated, and he predicted that the demand for its service will continue to increase at an accelerated rate during the next decade.

He expressed the opinion that "the fuel revolution"—as designated by Fortune magazine—or the production of oil from coal, shale, and natural gas will result in an oil too expensive for boiler use, but the increased demand for coal will result in higher coal prices which in turn will give economically operated district heating plants an even greater advantage than at present over boiler plants operated for single buildings or factories.

Committee Reports Show Progress

Progress in district heating was further emphasized by the reports of the operating statistics and sales development committees. Ernest T. Smith, The Detroit Edison Co., chairman of the operating statistics committee, said that 95 percent of the steam utilities reported increased sales during 1947—as might be expected, since colder weather was reported by 83 percent of the companies. On a company average basis there was a total increase of 12.52 percent in the number of degree-days. However, there was an increase of 24.14 percent in the total revenue in 1947 over 1946. Only two companies, which are located in the Pacific district where warmer weather was experienced, reported decreases. The total average revenue per thousand pounds of steam sold increased 7.13 percent. Six companies, however, reported a decrease in average revenue.

The report also showed that fuel costs continued to rise in 1947. The average cost of coal per million Btu increased 15.30 percent over that of 1946 or double the increase in 1946 over 1945. The increase in total hourly wage cost was 19.44 percent. Capital investment increased 4.0 percent. The length of steam distribution mains and service mains increased respectively 2.78 and 2.04 percent.

Of 46 large utilities reporting sales statistics to Sterling S. Sanford of the sales development committee, 39 obtained a total of 1008 new customers, with an estimated annual steam consumption of 1,467,285 Mlb and an annual revenue of $1,360,340; one company obtained a total of 117 new customers with an estimated annual steam consumption of 1,266,565 Mlb and an annual revenue of $1,328,757, and six companies reported no new business, probably in most cases because they had previously sold to the limit of their capacities.

Ten companies reported losing 45 customers and the company that gained so many new ones reported a loss of 23 customers.

Steam rates were reported on by L. A. Mollman of St. Louis for the rates and regulations committee, of which Harry A. Weitzman, of the Rochester Gas and Electric Corp., is chairman. The report reflects the increased cost of labor and materials.

Growing Recognition of Fuel Clauses

Growing recognition of the worth and importance of "fuel clauses" in

New NDHA officers are Alfred T. Veness, third vice president; George H. Tuttle, second vice president; Henry L. Martin, president; David W. Loucks, first vice president. The author, John F. Collins, Jr., continues as secretary-treasurer

steam rates was in evidence. At the end of 1947, 56 of 67 steam utilities furnishing statistics said they had one or more rates containing such clauses. Ninety-eight of 129 rates reported contained fuel provisions.

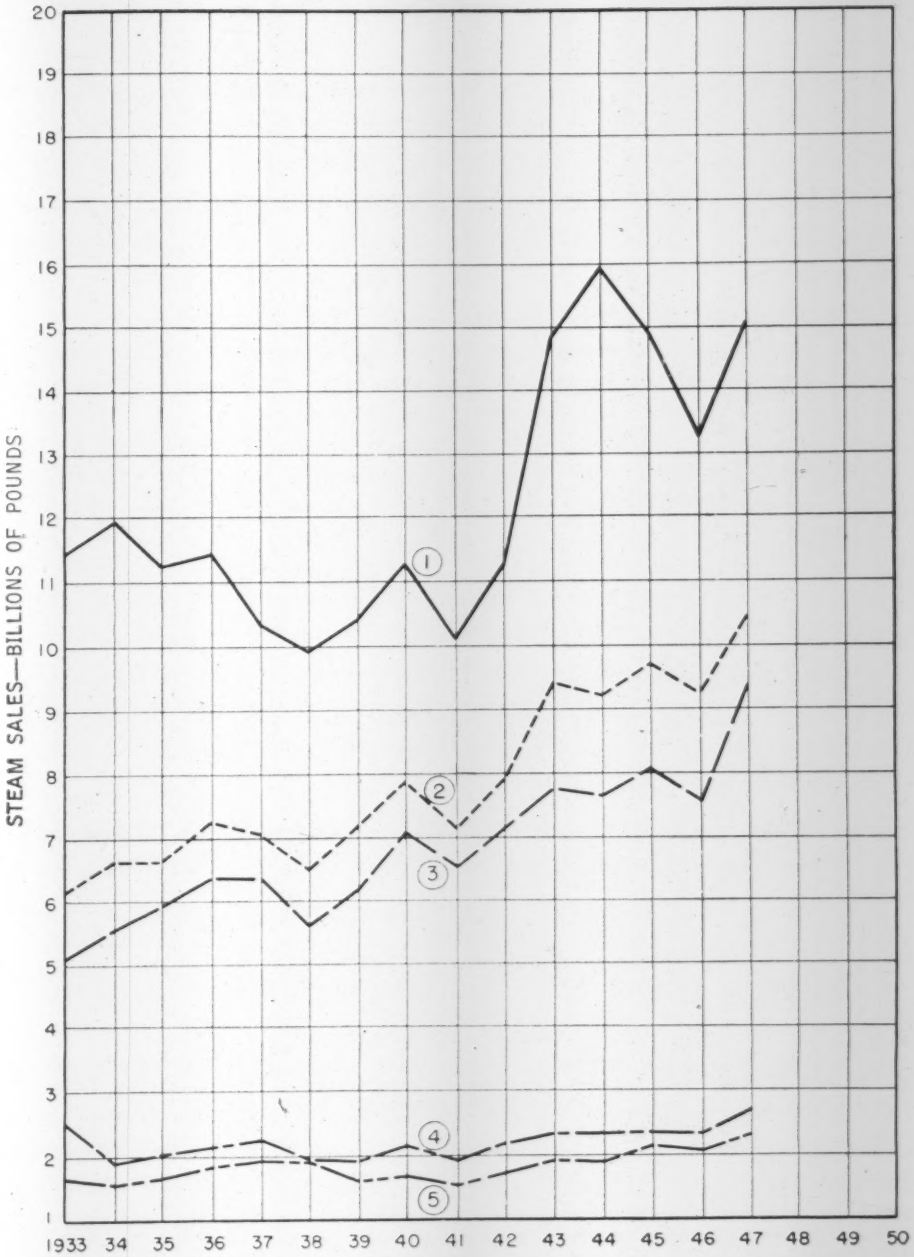
The committee reported that in five cities both base rates and fuel clauses had been increased—the least 20 and the most 38 percent; in seven cities fuel clauses had been added and base rates increased between 10 and 60 percent; and in 14 other cities base rates had been increased between 7 and 33 percent. Three cities were reported as adding fuel clauses. Four increased base rates but decreased fuel clauses, a net of between 8 and 19 percent. On the other hand, in 49 cities steam suppliers had not up to the end of the year filed higher rates to overcome increased costs. There were no cases of rate decreases. Increases were in general being approved by regulating bodies as they gave recognition to the changing times, but many such approvals were given on a temporary basis.

New Edition of Handbook

The NDHA has been engaged for some months in the writing of a third and entirely new edition of the District Heating Handbook covering all phases of the industry. The chairman of the educational committee, J. Earl Seiter (of the Baltimore heating utility) reported authors' manuscripts of 10 of the proposed 15 chapters had been completed and all phases of the effort going ahead at a rapid pace. He estimated a year would elapse before the new 700 page volume would be available.

In the author's annual report, it was pointed out that the headquarters staff continued to spend a considerable portion of its time on the answering of questions on district heating received from persons and organizations all over the world. The association is in excellent financial position, and the only aggravating condition is the difficulty of obtaining printed matter in a reasonable length of time in these postwar days.

A past president of the association and long an ardent worker for it—and likewise a past president of the National Association of Building Owners and Managers—Earle Shultz, vice president of the Illinois Maintenance Co. of Chicago, by unanimous ballot was elected to honorary membership in the NDHA, its highest award, and presented with an illuminated certificate in token thereof.



Steam sales as reported by member companies of the NDHA. The reports are divided into five groups based on volume of the annual sales

During the closing session of the meeting Henry L. Martin, of the Boston Edison Co., was elected president; David W. Loucks, of the Allegheny County Steam Heating Co., Pittsburgh, was elected first vice president, George H. Tuttle, of The Detroit Edison Co., was elected second vice president and Alfred T. Veness, of the Rochester Gas & Electric Corp., was elected third vice president, all for the coming year. John T. Davis, Indianapolis Power and Light Co., Charles W. Deeg, Philadelphia Electric Co., and Albert R. Mumford, of the Combustion Engineering Co., New York City, were elected to the executive board for terms of two years. Other directors who remain in office for another year are Thomas P. Brown, Jr., New York Steam Corp., Percy A. Hyde, Ohio Edison Co., Akron, and Milton A. Hanna, of the RicwiL Co., Cleveland. The author continues as secretary-treasurer.

An article summarizing the technical data presented at the meeting will be published in a coming issue.

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INDUSTRIAL AIR CONDITIONING

Coordination of Architectural and Engineering Design

F. F. STEVENSON and JACK F. SALSBURG, designing engineers with a great deal of experience in air conditioning for industrial and other types of buildings, stress here the importance of coordinating the architectural and mechanical designs. They give examples and practical comments based on their own work. Earlier articles by Mr. Stevenson have described various methods of cooling and dehumidifying. It would be interesting if other designers would comment on points presented in this article, for publication in our "Open for Discussion" department

THE ARCHITECT and mechanical engineer have six major objectives when installing an air conditioning system in a new building. They must consider: (1) Performance of the system. (2) Amount of space used and the cost thereof. (3) Cost of the installed system and cost of operation. (4) Ease of installation. (5) Accessibility for future servicing. (6) Appearance.

Naturally all parties concerned expect the system to perform according to design, at an initial cost and an operation cost satisfactory to the owner. It must not use high priced productive space. It should not have tedious or unexpected installation problems—these will add to the cost quicker than anything else. It should have no inaccessible locations for controls or valves which require adjustment; when it is necessary to organize an exploring party to get at such gadgets, adjustment or servicing becomes very expensive.

"To Be Felt But Not Seen"

As to appearance, there is an old saying that fits nicely here—"To be seen and not heard." We can paraphrase this to say, "To be felt but not seen." In other words, the air conditioning system should be in there pitching, but not at the expense of marring the appearance of the building, either on the inside or the out. Everyone has seen buildings whose roofs are littered with oddly assorted penthouses, leantos, ventilating stacks, and what have you. Modern design in air conditioning does not tolerate such things. It is possible to have all structures and equipment pertaining to the air conditioning system blend in with the architectural design and appearance of the building, but this requires simultaneous decisions on architectural and mechanical work well in advance of construction.

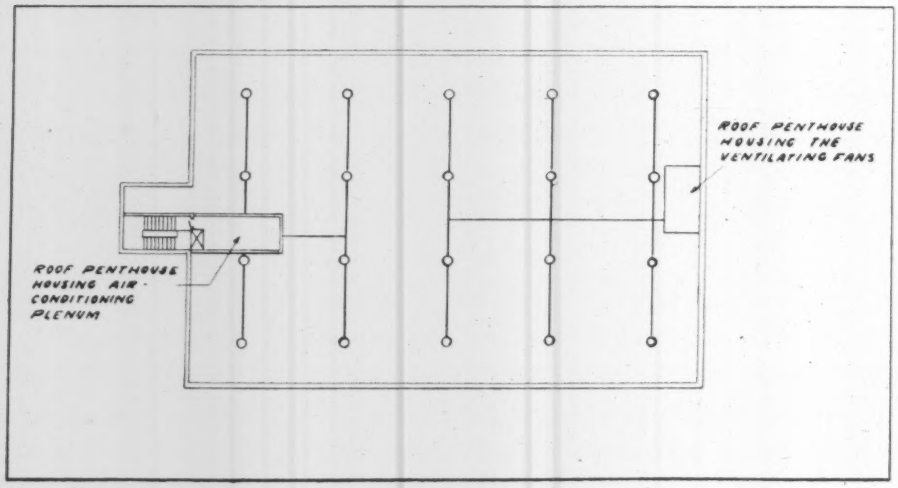
The accompanying drawings deal with typical industrial buildings in the small or medium size class, and are intended to suggest how architectural and mechanical cooperation can be applied in practice. They may be one, two, or three stories in height and there is an excavated basement at each end. The floors and roofs are concrete slab. Ceilings are suspended from the slab, with furred spaces between. The entrance and main stairway are housed in an ornamental tower in the front end of the building. There may be another such tower in the rear end of the building. A freight elevator is located in the rear.

The refrigeration equipment used for air conditioning is placed in the front basement. It should be remembered that such spaces require ventilation, preferably mechanical, so means of getting air in and out of them must be provided. The heating plant is in the rear basement. Thought must be given to ventilation here, also.

All fans and air treating equipment are placed on the roof in penthouses which are of substantial construction and designed to blend in with the architectural appearance of the building. Located in the rear of an ornamental tower they appear as a part of the tower, rather than as separate structures. Even the air intake and outlet stacks are designed to harmonize with the general structural appearance.

The water used for refrigerant condensing is not recirculated in these examples, so evaporative condensers or cooling towers need not be considered. However, on systems

Fig. 1



where evaporative condensers or cooling towers are required, they can be placed just back of the penthouse to blend in with the building's architectural appearance. Heating in the winter is by means of radiation and unit heaters, with the ventilating air being tempered to the desired temperature.

Fig. 1 shows a plan view of one of these buildings. The office and laboratory space in the front end is air conditioned and the factory space mechanically ventilated. There is an ornamental tower in the front of the building. The penthouse in the front end enclosing the air conditioning equipment is just in back of the tower and, looking from the outside, it seems to be a part of the tower. Between the penthouse and the tower a large air shaft extends from the roof to the basement. This is used for air duct and pipe risers.

A smaller penthouse is placed in the rear of the building to enclose the ventilating fans and winter tempering coils. One end of the penthouse is on a line with the rear wall of the building and is designed to form a part of the wall facade. An air shaft similar to the one in the front end of the building serves the penthouse. It abuts the freight elevator shaft.

Fig. 2 shows a plan view of another similar building with ornamental towers at both ends. The entire building is air conditioned and there is a penthouse with its accompanying air shaft in back of and blending into each tower. As in Fig. 1, the penthouses are placed in the rear of the ornamental towers of the building and an air shaft between the exit of the plenum and the tower. The shaft carries steam and refrigerant pipes and supply and return air duct risers. There is ample furred space under the plenum floor to carry ducts.

As a considerable depth of space may be required underneath the air conditioning penthouses, the structural design must be such as to meet this requirement. The roof level may be raised at this area or the floor of the penthouse may be elevated a couple of feet above the roof slab. This latter method will provide two furred spaces for the passage of air ducts, one between the penthouse floor and the roof slab and one between the slab and

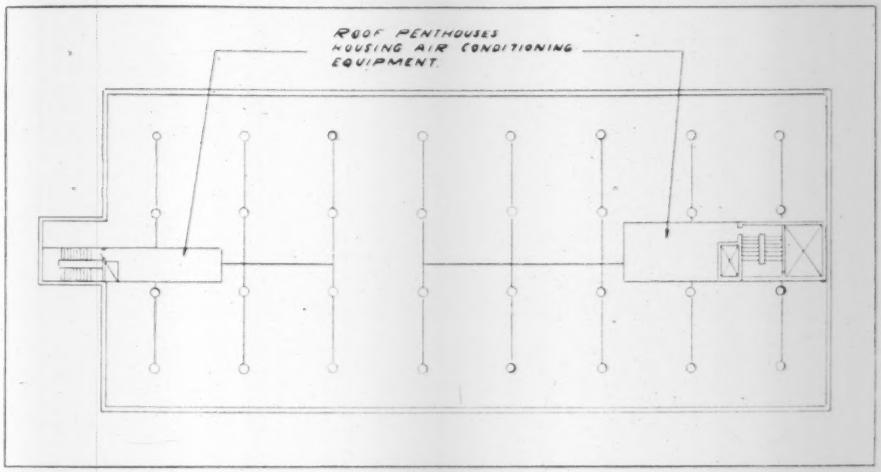


Fig. 2

the suspended ceiling. The roof slab must be fabricated with openings at the proper locations for the passage of ducts.

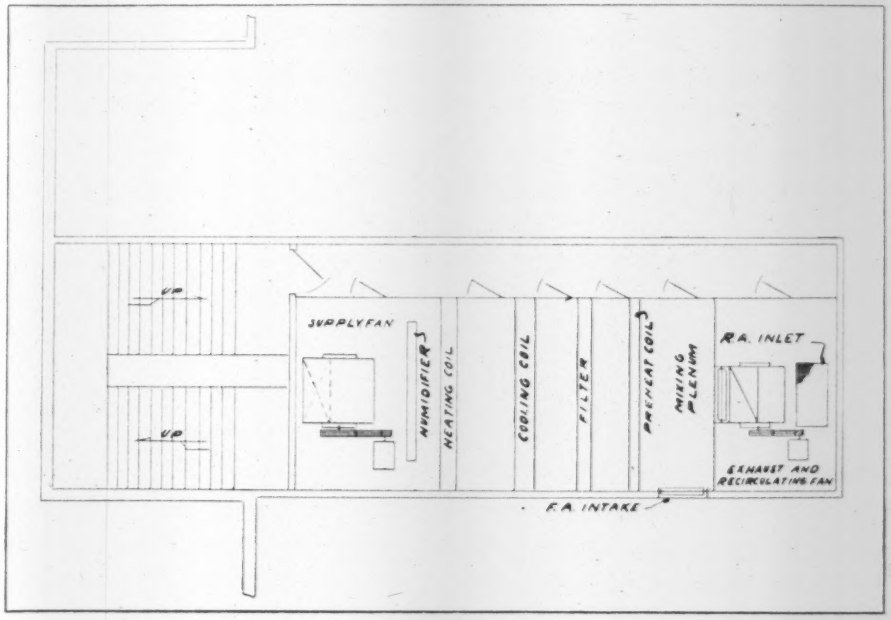
Figs. 3-8 are detailed plan and elevation views of penthouses, enclosing the plenums, fans, and air treating equipment.

Two Blower Fans Used

In the air conditioning systems of these examples, two blower fans are used—one supply and one recirculating and exhaust. The volume of outside air used in normal operation is large and during certain periods of the spring and fall all outside air will be handled—hence the use of two fans. Incidentally, the time when it is advantageous to handle all outside air is much less than many designers seem to think. In the system we are describing, the inside design temperature varies from 83 to 72 F during the summer season, when the outdoor temperature ranges from 100 to 70 F. During spring, fall and winter the system delivers tempered air ranging in temperature from 74 to 68 F. The system will handle 100 percent outside air between outdoor temperature ranges of about 68 to 77 F. In the lower temperature brackets, the outside air may have to be reheated slightly and in the higher, it may require cooling and dehumidification. In the upper bracket, the moisture content of the outside air is the determining factor.

The systems described herein are suitable for the layout of Fig. 1, in which only the office and laboratory space at one end of the building is air conditioned. They are not zoned, as it is felt that the additional expense involved in zoning is not justified when only two or

Fig. 3



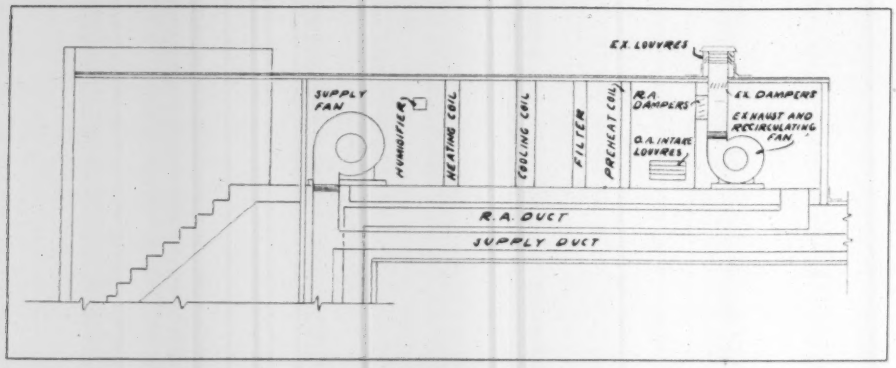


Fig. 4

three degrees variation in temperature will result from not zoning.

The recirculating fan of these systems is sized to handle about 85 percent of the supply air volume and is powered to work against the resistance of the return duct circuit and a very small positive discharge pressure. The supply fan carries the total air volume and is powered to work against the resistance of the plenum and the supply duct circuit.

An alternative of the two fan system would be to use a supply fan only and place exhaust intakes, with ducts, in the air conditioned spaces. As more outside air is used, raising the air pressure level of the spaces, the intakes would be opened by the action of pressure controllers, and air exhausted through the ducts to outdoors. This method involves the use of much more duct work and many individual controls and is not deemed especially practicable for the average installation.

When two fans are used, the exhaust circuit leading from the discharge of the recirculating fan should be designed for as low a resistance as possible. It is this resistance which determines the discharge pressure of the fan, and when the fan is discharging part of the air to outside and part to the mixing chamber, the static pressure of the air delivered to the mixing chamber should be at a minimum. The mixing chamber must be maintained at a negative pressure, in order to draw in outside air, and if the recirculating fan delivers air at even a small positive pressure, the return air opening must be severely throttled in order to keep the return air volume down at the required level.

Figs. 3 and 4 show double inlet, double width, blower fans used for recirculation and supply. In order to use these fans, we must have airtight plenum chambers housing the fans and unless we are satisfied to have the motor loss heat go into the air stream, we must arrange a housing for the motors to divert this heat elsewhere. Inlet boxes could be used instead of airtight plenums but these are not in great favor with some designers. The waste heat of a motor (due to the motor being less than 100 percent efficient) may not be too important, because, even with single inlet fans, using tight enclosures at the intakes, most of the heat of useful work goes to the air stream and this heat emission is much greater than is the waste heat.

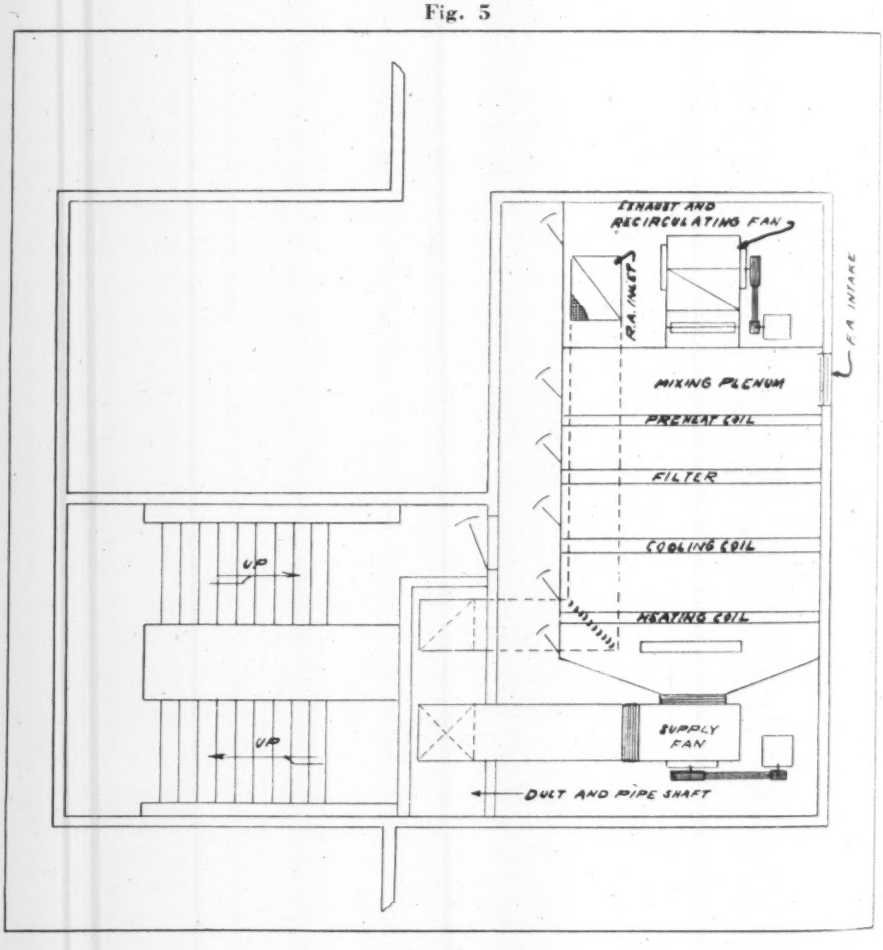
There are several advantages in the use of double inlet, double width fans, in our opinion. First, they make for smaller bulk than a single inlet fan—especially height, which is usually important. Also, they give a straight line flow of air through the plenum circuit, which may be very helpful when laying out the intake and discharge ducts.

Return air is delivered to the plenum through an opening in the floor, is picked up by the double inlet fans, and either exhausted through the exhaust stack to outdoors or delivered to the mixing plenum on the discharge side of the fan. However, most of the time the fan will be partly exhausting and partly returning air.

The mixing plenum is partitioned off from the airtight fan intake chamber and is open to outdoors. This chamber must be maintained at a sufficient negative pressure by the supply fan in order to induce the required flow of outside air into it.

For summer operation it is best to have the louvered opening for the outside air located at a low

Fig. 5



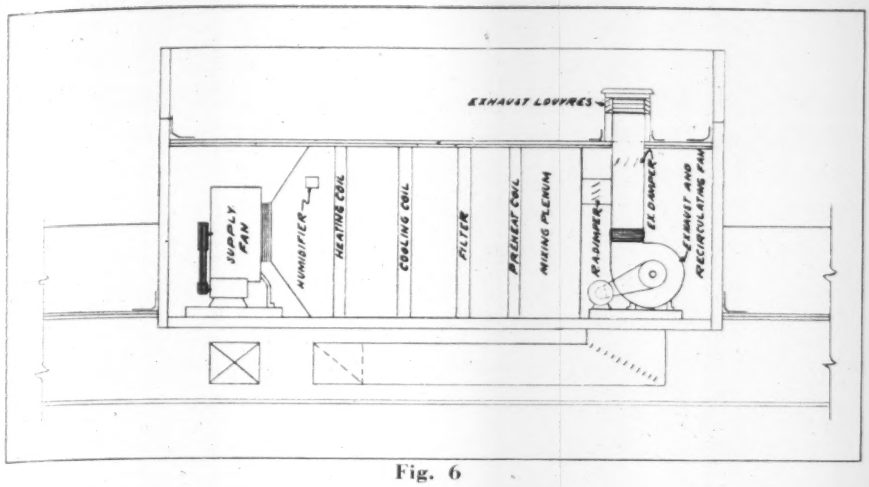


Fig. 6

level. The outside air is warmer than returning air; with the intake low, better mixing should result.

The outside air intake is equipped with two louvered dampers, one a minimum damper and the other a maximum. The minimum damper is either fully closed or wide open, and of course is opened only when the system is in operation. The maximum damper modulates between fully closed and wide open.

The louvers of the latter damper should be of the proportioning type—that is, each blade rotates in the opposite direction from the one next to it. Such dampers give a greater modulating range and a flatter curve of movement. The return air and exhaust air openings are dampered and synchronized with the outside air dampers.

The exhaust stack is of masonry construction, to harmonize with the building design, and can have louvered openings around all four sides at the top or one large opening on the side away from the outside air intake opening. Care must be taken, of course, that the exhaust air does not short circuit into this opening. Direction of the prevailing wind is of considerable importance in the location of exhaust and intake openings.

In recent years, the roofs of buildings often have been sprayed with water to reduce the air conditioning load. If this is done, it seems best to draw in outside air from a point as high above the roof level as possible. It has been found that during times of low wind movement, that the air is well saturated with moisture for a distance of several feet above the sprays. Therefore, if the roof is sprayed, instead of taking in outside air from openings in the plenum wall, stacks should be connected to such openings. In this case the openings may be placed high on the plenum wall or in the ceiling.

Use of Preheat Coil

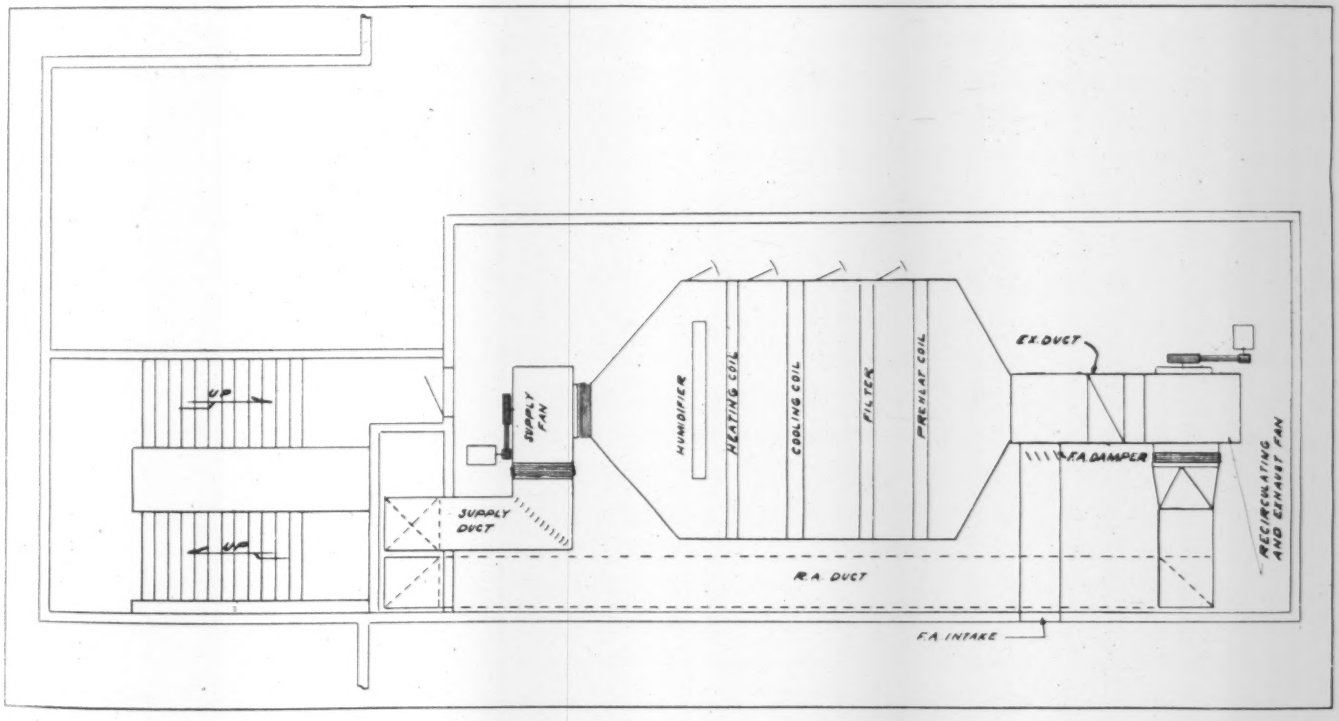
A preheating coil is shown ahead of the filter, although such a coil is seldom used when the system has a reheat coil at the exit of the plenum, unless large proportions of outside air are used in the winter. A preheat coil at the outside air intake could be used, but then we have the problem of deciding whether to use one row or two and with what valves or the installation of face and bypass dampers. Unless there is a definite reason for needing preheat, it is better to eliminate this coil. Oil filters are guaranteed to work efficiently on low temperature air, so preheat coils are not needed on account of the filter.

Trouble with oil filters is caused by too warm air rather than too cold. Oil entrainment in the air stream can result from air being heated too much by preheat coil.

The cooling coil is on the downstream side of the filter. This coil should be arranged with connec-

[*Concluded on page 104*]

Fig. 7



HEATING with ELECTRICITY

Foil strips connected to 110 volt line current are used in one method of employing electric resistance heating

Carl F. Boester Comments Briefly on Two Methods of Space Heating

EDITOR'S NOTE—Carl F. Boester, housing consultant for the Purdue Research Foundation, Lafayette, Ind., is widely known for his studies of and ideas about unusual methods of heating and air conditioning. With the current interest in the heat pump and other forms of heating with electricity, he is often asked for his thoughts on design and installation. In partial answer to such questions, he has prepared these two short articles, which describe some of his work.

Radiant Heating--by Electric Resistance

CONSIDERABLE research and develment has been directed recently toward the use of electricity not only as auxiliary but as primary heating, employing resistance type elements at low temperature over large surface areas to heat by radiation. I have a "super-insulated" test structure in which there are several heat pump installations. It was desirable to have an exact rather than an estimated heat loss figure for the structure so a year's operation on electric resistance heating was decided upon to get a close check. The heat load was estimated as 23,000 Btu per hr for 960 sq ft of space with a volume of 8000 cu ft. The structure is all aluminum clad. The wall "*U*" value is 0.065, indicating the degree of insulation.

It was also reasoned that if a usage factor were applied to the energy consumption, direct resistance heating might have an operating cost comparable to that for heating with a heat pump. If a usage factor were to be employed to conserve current, a system would have to be developed that could establish a design mean radiant temperature in a given room rather rapidly.

The ceilings and walls were covered with a very low density wood fiber wallboard 1 in. thick so as to insure low thermal capacity, the idea being to have rapidly heat emitting surfaces without heating the materials comprising or in back of the surfaces. An accompanying photo shows the ceiling of one of the rooms, which is 12 x 20 ft. To gain quick response and yet be able to split the load, the ceiling heating system for this room was divided into two circuits. One half of the area, 10 x 12 ft, had applied to it

400 lineal ft of 0.00065 in. aluminum foil, 1 in. wide. The foil was paper-mounted for easy handling. The strips were equally spaced and applied by stapling. Ordinary wall paper applied in the usual way over the strips completed the job.

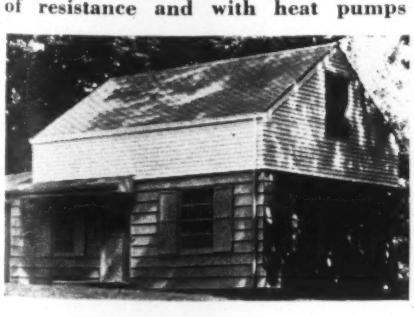
The foil resistance element was directly attached to 110 volt line current; it draws for this application, 20 amp of current. This is equivalent to about 7500 Btu per hr, which is more than the room heat loss—yet only half of the room ceiling is covered. Since quick heat-up is desired, two circuits are used employing the whole ceiling. This brings the room up to the design mean radiant temperature rather rapidly; therefore, it is possible to shut off the current when the room is not in use.

A standard thermostat "rides" herd on the room air temperature to shut off the current. It thus serves as a control while the room is occupied. On long hours of use the ceiling doesn't heat up to over 140 F. Operating costs depend on electric rates, hours of use, and other qualifications.

On another installation walls and ceilings are treated in a similar manner, this job being designed for a maximum temperature of 70 deg for all surfaces. Different foil resistance elements than the ones described above were of course required.

Another idea is to make electric radiant heating panels using ordinary foil backed wallboard. The foil on this is 0.00035 in. The 4 ft by 8 ft board is placed on a table and the foil cut into circuits using a paperhanger's straight-edge and roll cutter. A continuous circuit 1½ in. wide on a 4 ft x 8 ft board will draw about 13 amp and yield about 152 Btu per sq ft per hr when mounted vertically. It is of course connected to 110 volts. Multiples of such panels can be used to heat any space. Lower output is obtained by narrower circuits, so in cases where many panels at a lower temperature are desired it is easy to design to the problem. It should be mentioned that the strips are cut 1½ in. short on alternate ends to form the continuous circuit of foil.

"Super-insulated" test structure used for study of electric heating by means of resistance and with heat pumps



The foregoing suggestions and ideas have been made by the author for the benefit of those interested in experimenting with electric resistance heating by radiation. If a business is contemplated around such ideas, then patents and patent applications should be investigated.

Heat Pump—an Earth Buried Heat Exchanger

IMPROVED EQUIPMENT and rising fuel costs—together with the compelling impetus of a widespread demand for summer cooling—has caused a revived interest in the heat pump. Public interest in the idea of obtaining heat from the earth has also helped to soften the resistance to this method.

The earth is only one of several sources of heat for the heat pump as a means of providing winter heating, and as a heat absorber in the cooling cycle. The limitations on the use of the earth for such a purpose are manifold but much research and experimentation has been done which will permit reasonably reliable design procedure.

My experiences have taught me many things that should not be done. If, however, I were asked what to do I'd make the following suggestions. When it is desired to employ an earth buried heat exchanger there are many factors to consider—such as the thermal characteristics of the soil, the performance of the exchanger surface at the point of contact with the earth, and the length of time the exchanger is to perform as an evaporator or condenser as required. There are numerous other variables and considerations, but from a strictly practical and economic viewpoint some overall exchanger design must be worked out to fit all average conditions. This being so, I'll design an exchanger to have a capacity of 10,000 to 12,000 Btu per hr per hp of pump capacity for a reasonable variation of conditions—whether the exchanger is employed as an evaporator or as a condenser.

For each ton or horsepower of such capacity I'd suggest a trench in most any soil 2 ft wide, 8 ft deep, and 22 to 25 ft long. In this trench I'd place a coil made up of ⅝ in. OD copper tubing using 20 ft lengths. The coil would have approximately 500 lineal feet of tubing, equal to about 80 sq ft of tube surface. I'd arrange the coil in four circuits each 125 ft long. The tubes would be spaced 6 in. apart horizontally and 18 in. apart vertically. The tubes should be so arranged and pitched for good refrigerant flow and drainage. Oil or useless liquid refrigerant should not be in the tubes. A common header would connect each of the four circuits. I'd use wallboard as a temporary support in fabricating the coil, and to control the proper spacing of the tubes. Holes properly placed in the board would insure this. Return bends of soft tubing would be welded in place to form the continuous circuits.

Valve and Header Connections

An accompanying sketch illustrates the valve, headering, and coil connections. Since the heat exchanger is used not only as an evaporator but also as a condenser, check valves as indicated insure the correct flow of refrigerant whether as a gas or as a liquid. When condensing in the coil, liquid condensate drains out the bottom header past the check valve into the main liquid line. When the coil is used as an evaporator, liquid refrigerant from the main liquid line goes through the indicated heat exchanger of spined tubing. The subcooled refrigerant then enters the coil through a gas-charged multi-outlet expansion valve. The remote bulb of the valve should be of the insert type.

Capillary tubes may be used instead of an expansion valve; in

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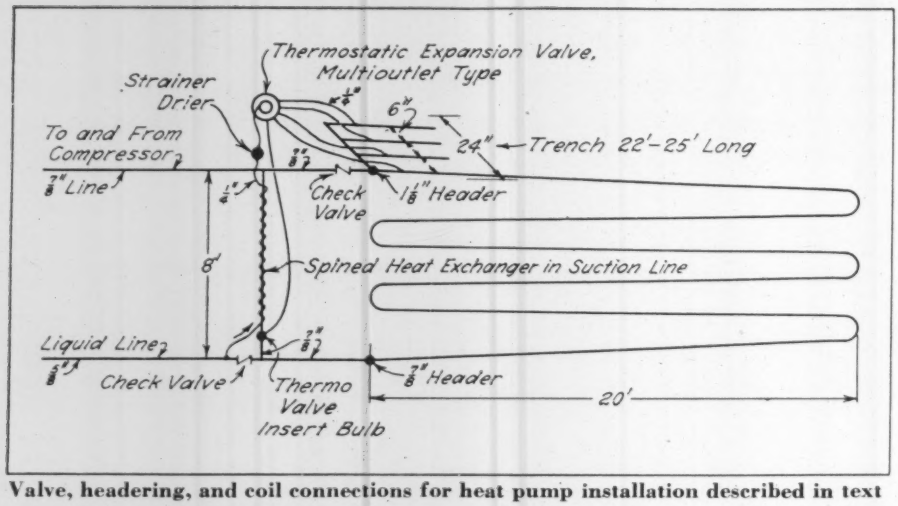


Valve, headering, and coil connections for heat pump installation described in text

either case a drier type of strainer should be employed ahead of such device. As shown, the tubes from the expansion valve enter the coil at the top. When the coil is evaporating, the suction gas is withdrawn from the bottom of the coil. When the coil is condensing, hot gas enters the coil at the top and condensate leaves at the bottom. Whether condensing or evaporating, the coil is always relatively dry so that an excessive refrigerant charge is avoided.

The above sized coil is designed to handle the equivalent of 1 hp of compressor. At times, under varying load conditions, this coil will overload the compressor; therefore, a pressure operated hold-back valve is necessary in the suction line ahead of the compressor to prevent such overload. After a few hours continuous use, the coil yield will match compressor demand.

Back-Filling the Trench

Before the coil is placed in the trench provided for it, the bottom and walls of the trench should be heavily sprayed with used oil, such as crankcase drainings, in order to retard the leaching out of the water from the special mix used to fill the trench. After the coil is placed, the trench should be back-filled with a mixture (thoroughly worked together in a plaster mixer) of 10 lb of bentonite clay and 15 lb of the earth to which is added 50 lb of water. Enough of such a mixture is employed to fill the trench. The special clay retains the water over a long period of years; in effect, therefore, the mixture has a high potential of latent heat of fusion which permits a high yield of heat when needed and a better chance for the surrounding earth to yield heat to the coil. Freezing of the earth mixture around the coil is necessary to get the latent heat of fusion but this does not affect, in a practical way, the flow of heat to the coil.

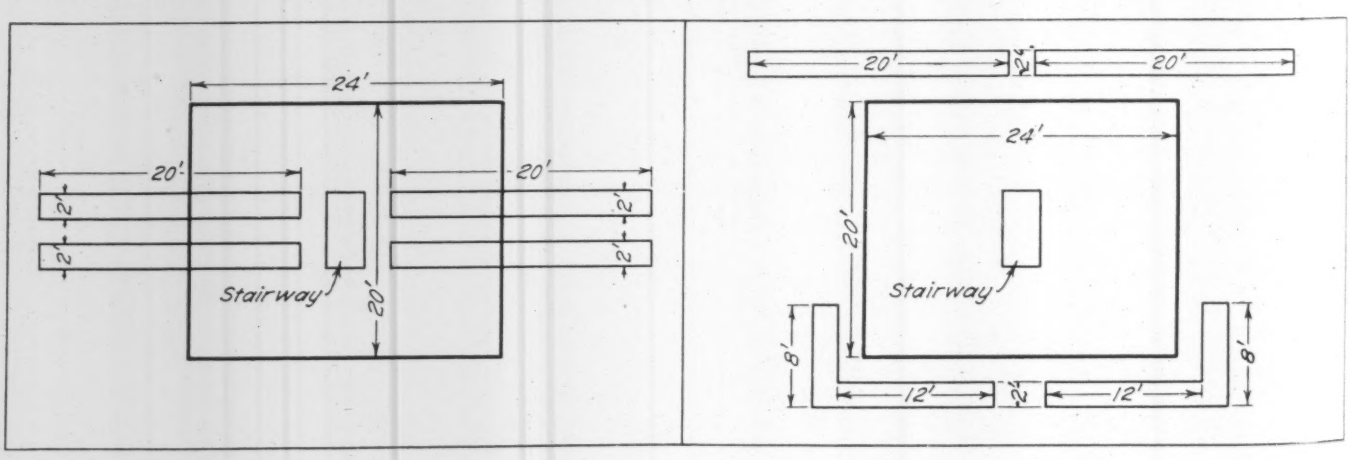
With no basement, the ground coils can be placed under the structure inside the footings, as shown at left. With a basement, the coils are placed against the foundation wall, as shown in the upper part of the right sketch; or they can be made to bend around the foundation walls, as indicated in the lower part of this sketch

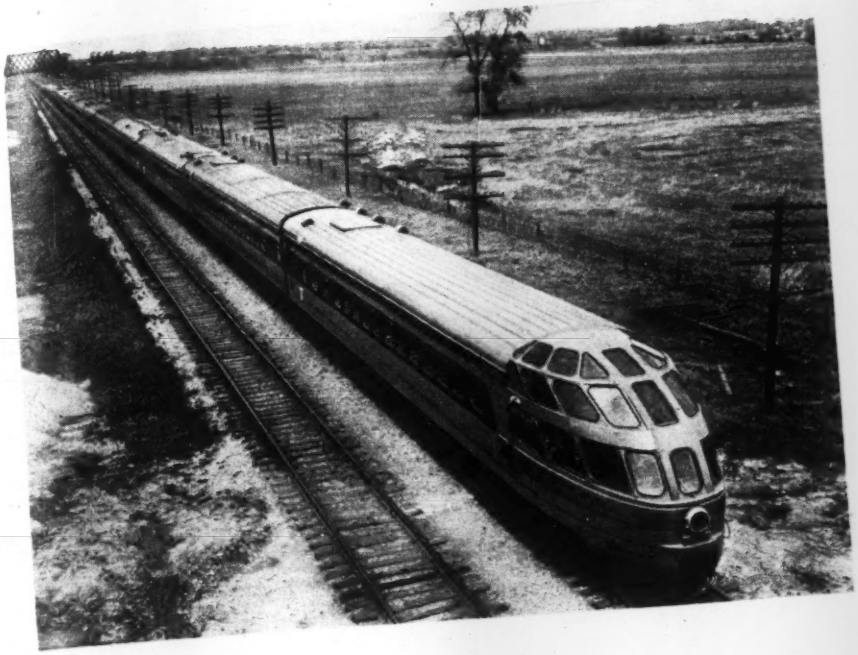
There are several structures of the size shown in an accompanying photo having such coil installations.

With a basement, the coils are placed against the foundation wall, as indicated in one of the sketches. If the lot is narrow, the coil can be made to bend around the foundation wall. If there is no basement the coils can be placed under the structure inside the footings, as shown in another sketch. In each instance, the compressor is close to the coil headers. If expansion valves are used, they must be placed for easy servicing.

I am currently experimenting with a septic tank type heat exchanger made up of plate type coils. Such a tank is 36 ft long, 18 in. wide, and 30 in. deep. It is placed in the usual type of sewer trench. Much waste heat is recovered from water leaving the structure. Since the tank is buried, earth heat is also picked up. The tank discharge goes to a tile bed or the city sewer. If a tile bed is used, it is returned along side the septic tank to insure moist earth around the tank. Such a tank should easily handle a 3 hp heat pump.

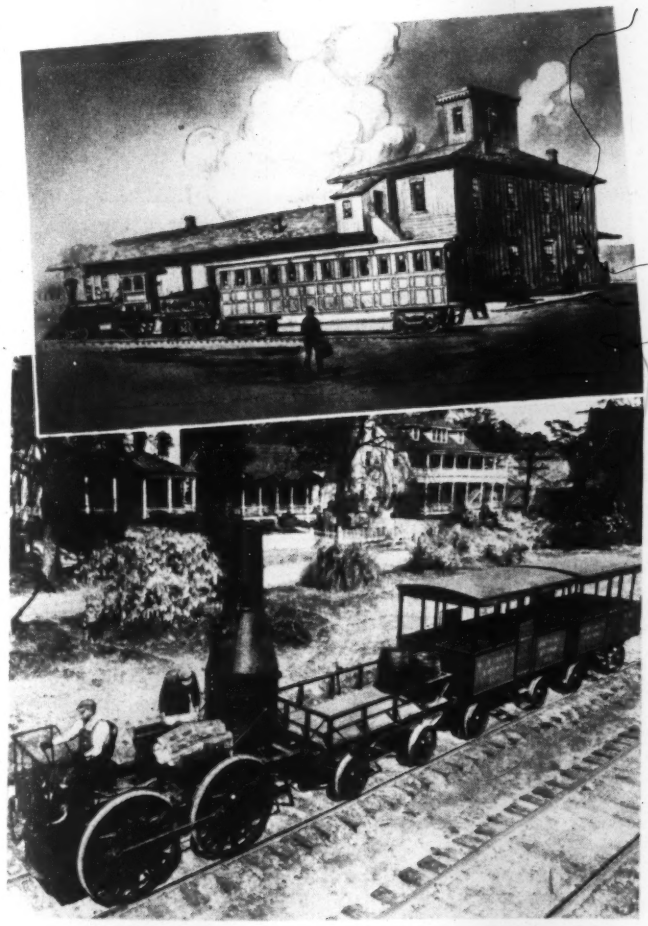
In discussing earth buried heat exchangers, it should be mentioned that there is more to well designed heat pump installations than just the earth coil design. The air or load side of the system is quite tricky, too, but it is not the purpose here to discuss all the aspects of the heat pump. Any engineer who would like to experiment with the heat pump and employ either of the exchangers described is encouraged to do so. If, on the other hand, a business is contemplated around any of the ideas, patents and patent applications do exist—so proper permission should be obtained beforehand.





Here's one of the trains of today, the Milwaukee Road's new Hiawatha. The observation parlor car has a "sky-top solar lounge" with 90 percent transparent area of heat and glare resistant glass. All cars are air conditioned, of course, and are equipped with public address and radio

Railroad Fair Opening This Month Will Depict 100 Years of Progress



THIS YEAR is the 100th anniversary of the beginning of the opening of the west by railroad transportation, for in 1848 the tiny Pioneer, a 10 ton wood-burning locomotive, pulled out of Chicago on a history-making maiden journey that ended five miles away where the strap rail track came to an end.

The Chicago Railroad Fair—opening July 20 on the lake front and running until mid-September—will mark the anniversary. Features will include an outdoor pageant, Wheels A-Rolling, illustrating the part played by railroads in the history and development of the U.S.A. There will be extensive exhibits presented by railroads and railroad equipment and supply firms. On 10 individual tracks will be models of all types of passenger and freight cars—modern and historical—and the name trains of 1948 will be featured.

Upper: The Chicago Railroad Fair marks the 100th anniversary of the maiden run of the Pioneer, a wood-burning locomotive

Lower: You might call this train—which was named the Best Friend, and which was placed in service in 1830 in the south—air conditioned by nature, although the passengers enjoyed smoke, dust, and dirt along with the fresh air

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Here Are Suggestions for *CLEANING DUCTS*

In the May issue of HPAC, "F.F.." asked for information on methods of cleaning ventilating ducts and equipment, and the various solutions used to remove grease, etc.

Problems encountered in cleaning blowers and ducts will be dependent upon the primary function of the duct system. A duct system may be installed to handle sawdust and chips from woodworking machines, abrasives from grinding wheels, powders and residue from polishers, dust from a foundry floor, or corrosive vapors from vats. To make the above list complete nearly every industry would have to be considered. The point is, that while the primary function of a duct system may be to remove emery dust or kitchen odors, it also aids (or may entirely comprise) the ventilating system of the area. As such, the system must be properly evaluated for its contribution to maintaining the space at design conditions.

There are several general principles which should be followed in the design of duct work. Often times there will be no cleaning problem if these commonsense items are employed, whereas their omission may result in a system requiring unreasonable maintenance.

1) Make joints tight with lap in the direction of air flow.

2) Locate cleanouts every 15 to 18 ft and fit with tight doors with quick opening latches.

3) Keep runs as direct as feasible.

4) Elbows should be at least 1½ times the duct diameter.

5) Recommended thickness:

Gage	Diameter In.
18	26 & up
20	19 — 25
22	18 — 9
24	up to 8

6) Use elbows two gages heavier than straight ducts.

7) Use extra heavy pipe for permanent installations handling abrasive materials.

In some situations special pockets are set at points of reduced velocity to collect heavy particles. Cinders, dust, and dirt may be removed by placing slots in the scroll of the fan housing. A cyclone separator is often used to remove suspended material.

Frequently the foreign material has a salvage value. A case comes to mind in the cosmetic industry where the ventilation air above a powder boxing table contained enough powder to make separation a decided economy.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

For corrosive fumes the entire system from inlet cone of blower or fan to termination of duct work may be lined with rubber.

Carbon Tet Often Effective

Cleaning operations on fans and blowers depend upon the nature of the deposit adhering to the blades or impeller. If the blades are readily accessible carbon tetrachloride will dissolve most grease-based residues. Other solvents are on the market but care must be taken if any inflammable solution is used. Carbon tet can be applied with a spray gun or paint brush. The solvent dissolves the grime and then evaporates, leaving the residue in loosened form so that the surface can be readily wiped clean.

For certain arrangements of equipment live steam can be used advantageously, either for the complete cleaning operation or for removing the residue after carbon tet has softened the deposits.

Sometimes deposits can be jarred loose as flakes or dust. The debris can then be removed at cleanout points or by a suction arrangement of a flexible tube fed along the bottom of the duct. In stubborn cases foreign matter may adhere tenaciously to the inside of ducts. If the use of solvents is out of the question for small ducts, the unpleasant task of disassembling the ducts may be the only answer.

A proprietary solvent with which I am familiar is often effective. This liquid is sprayed or painted on the greasy surfaces and then sprayed with water. Grease and grime come off when the water is applied. A phenol odor is liberated from the chemical reaction.

Swabs and Brushes for Ducts

Swabs and brushes are on the market which are effective if pulled through ducts. One type is a wire brush that looks like a chimney brush or a toilet bowl brush. The wires are fairly stiff and held together by a core which for 24 in. ducts is about the size of a man's forearm. The wires are pliable enough so that on rectangular ducts they flatten out on the narrow side and yet reach into the corners. A given size brush will work satisfactorily for a variety of duct dimensions. Upon coming to a reduced section in the duct, the bristles merely flatten out and the brush just drags a little harder.

For ducts much larger than 24 in. square the most effective method is to get inside and do the job by hand with carbon tet, scrapers, a vacuum cleaner, or whatever is expedient for the case at hand.—F.B.M.

TWO ARTICLES GAVE DATA ON DUCT CLEANING

THIS IS IN reply to "F.F.," who asked in the May issue for information on methods of cleaning ventilating ducts and equipment and the various solutions used.

"F.F." can find much of the information he desires on this subject in the excellent article by George L. Candler in the July 1947 issue of HPAC. Mr. Candler's remarks on solutions for grease removal seem to me especially valuable. He writes that his company's experience with hydrated lime has not been satisfactory because when blown over the grease it tends eventually to block up the system. "It coats the fan blades, finds its way into the fan motors and we are convinced that only a *clean* duct will not burn," he says.

Additional information on duct cleaning was given in two articles by Harold M. Toombs in the August and September 1945 issues of HPAC. Mr. Toombs reported on his experience in cleaning the air conditioning and heating equipment at the Stevens hotel in Chicago.

In connection with this question it might also be useful to quote from the Appendix on Maintenance, of the Standards of the National Board of Fire Underwriters for the Installation of Air Conditioning, Warm Air Heating, Air Cooling and Ventilating Systems:

"Inspection and Cleaning of Ducts

"a) Inspections to determine the amount of dust and waste material in the ducts (both discharge and return) should be made quarterly, except that if after several inspections such frequent inspection is found unnecessary, the interval between inspections may be adjusted to suit the conditions.

"b) Cleaning should be undertaken whenever inspection indicates the need.

"c) Cooling and heating coils should be cleaned, if necessary, at the time of cleaning the ducts.

"Note: Thorough cleaning of ducts may require scraping, brushing, or other positive means. Vacuum cleaning may not remove dust of an oily or sticky nature, or heavy accumulations in the elbows or seams. The amount and kind of dust and dirt will depend greatly on the occupancy and the arrangement of the duct system."—W.O.H.

What Is Best Way to Supply Steam and Electricity to College Buildings?

YOU ARE INVITED to comment on the following questions from a reader of HPAC—the chief engineer of a college—who wishes to remain anonymous for the present. Suitable discussion of the matters he brings up will be published, and paid for at regular rates (with additional payment for sketches). Address your remarks to The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan ave., Chicago 2.

"At present we have two 200 hp and one 150 hp water tube boilers operating at 125 psi; they are spreader stoker fired. These boilers are old, the two 200 hp's being installed in 1905.

"We have three 150 kw, 200 volt, d-c steam engine driven generators. We pump water from a deep well which supplies 200 gpm with a 220 volt d-c motor driven turbine pump.

"Our average electrical demand for 1947 was 193 kw.

"We are setting out these facts to show the inadequate electric facilities. We are aware that our lighting is inadequate, and that we are denying the faculty of the college many electrical conveniences that are very helpful in school work, and that we expect to supply the faculty with in case we do install proper steam and electric generating equipment for carrying the proposed increase in electrical load.

"We have on our campus at present nine buildings which are served from the previously mentioned power plant with steam for heating, electricity for lighting, etc. At present we are building two new buildings, and we feel sure that we are to get two more new buildings within 12 to 18 months.

"Our question is as follows: What would be the most efficient method and the most economical present-day equipment to supply steam heat and electricity to the previously mentioned buildings, considering the fact that all of the buildings are within a radius of 2000 ft from the central heating plant or the proposed central heating plant?

"Another question is: What would be the proper voltage to generate, and should it be a-c or d-c? We estimate our peak demand for electrical energy with the addition of the proposed new buildings to be 740 kw. The accompanying table shows the steam demand for heating of the present and new buildings."

Estimated Steam Demand for Heating and Miscellaneous Services

	Vol. Cu Ft	Steam Demand Lb per Hr	Present Heating Service
Existing Buildings			
Men's Dorm.	240,000	2,500	Exhaust
Library	358,153	3,600	Live
Science Hall	201,758	2,000	Exhaust
Agricultural Bldg.	201,758	2,000	Exhaust
Manual Arts	98,766	500	Exhaust
Academic Hall	1,130,335	11,000	Exhaust
Leming	197,065	2,000	Live
Albert Hall	170,689	1,700	Live
Training School	293,040	3,000	Exhaust
SUB-TOTALS	2,891,564	28,300	
Diversified Demand		18,300	
New Buildings			
Men's Dorm	482,000	4,200	
Service Bldg.	363,000	3,600	
SUB-TOTALS	3,736,564	36,100	
Diversified Demand		24,000	
Proposed Buildings			
Health & Education Bldg.	500,000	5,000	
Science Hall	200,000	2,000	
GRAND TOTALS	4,436,564	43,100	
Diversified Demand		28,700	

Dr. Giesecke Comments on Radiant Heating Problems

T. Napier Adlam's article in the June issue on problems related to radiant heating is based on many years of practical experience and is a valuable contribution. The following comments are submitted with the hope that they will add to the value of that article.

Spacing of pipes and resulting floor surface temperatures—I wonder whether the floor surface temperatures shown in Figs. 2 and 3 of the article are based on actual measurements or on theory. Actual temperature measurements which I have made are shown in Figs. A and B.

I have never seen a very great variation in floor surface temperatures except in a case where ½ in. copper tubing was laid on top of a concrete slab and covered only with cement mortar and tile. Excellent results can be secured when the coils are of ½ in. pipe spaced 6 in. on centers.

Maximum permissible floor surface temperature—I believe that the permissible maximum design floor surface temperature can be safely raised from 85 F to 90 F, because floor surface temperatures higher than 85 F are frequently encountered during the summer months and they do not seem to be objectionable. During the summer vacation of 1944 I measured surface temperatures in an unoccupied class room at the Texas A & M College and found that the floor surface temperature varied from 93 F in the morning to 100 F in the evening,

"OPEN FOR DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

the ceiling surface temperature from 94 F to 102 F and the four wall surface temperatures from 91 F to 101 F. The building was a masonry building with concrete frame and concrete floors, and with brick and tile walls. It was heated by solar radiation.

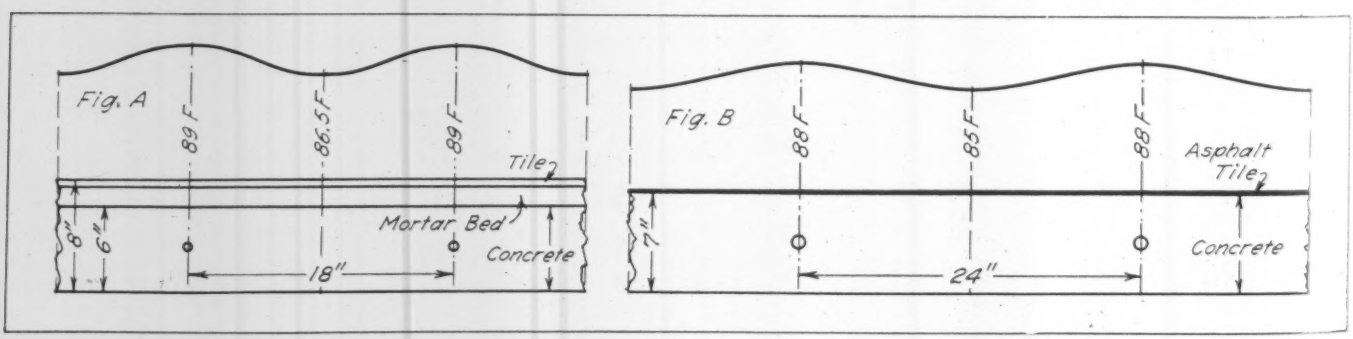
Effect of carpets and rugs on the heat emission of floors—Several years ago, tests were conducted at the University of Illinois to determine the loss of heat from metallic ducts and it was found—to my surprise—that the loss of heat from the duct was increased when the duct was covered with a single layer of asbestos. The explanation is simple—the addition of the asbestos increased the thermal resistance of the duct wall but it also increased the rate at which heat was emitted by the surface of the duct and the latter increase was greater than the former.

A similar condition exists when a floor is covered with a rug or carpet; the rate of heat emission by the floor may be decreased or increased or unaffected by the carpet, depending on the thickness of the carpet and on the character of its upper surface. In my home, one room has a polished wooden floor which is partly covered by a rug; when the temperature of the bare floor was 82 F, the temperature of the floor under the rug was 84 F, and the temperature of the upper surface of the rug was about 81 F.

The floor was heated by coils in the crawl space under the floor. I could not determine how the rate of heat emission by the rug compared with that by the bare floor. I hope this will be determined at the ASHVE Research Laboratory during the extensive research program relating to radiant heating and cooling which is now in progress there.

Development of leaks in embedded pipes—I have never seen a leak in a heating panel and do not understand what should cause such a leak. If the pipes are properly joined and tested and found to be

Fig. A (left)—Temperature measurements made by Dr. Giesecke with ¾ in. pipe spaced on 18 in. centers. Water flow temperature, 115 F; return water, 107 F; outdoor air temperature, 33 F; indoor, 70 F. Fig B (right) — Temperature measurements by Dr. Giesecke with 1 in. pipe spaced 24 in. Water temperature was about 110 F



free from leaks and then embedded in good concrete, the pipes should not rust from the outside any more than would the reinforcing rods in a reinforced concrete structure; and the pipes should not rust from the inside if they are kept full of good water. However, if through poor management the pipes should rust through from the inside the concrete hull should be thoroughly bonded to the pipe and should be impervious to the flow of water.

I have successfully stopped leaks in defective pipes by casting a concrete jacket, reinforced with hardware cloth, around the defective section of the pipe, as shown in Fig. C.

Are air pockets in heating coils objectionable?—In a gravity circulation, hot water heating system it is important to grade all pipe lines so as to avoid air pockets which might interrupt the circulation which is produced by very low heads. But in a forced circulation system, air pockets are not objectionable if the circulating pump has sufficient capacity to force the water through the air pockets.

In one of my installations it was necessary to place the pipes so that an 18 in. air pocket was formed (Fig. D) and I assumed that it would be necessary to install a vent at the point "V," but when the system was placed in operation the water pushed the air out of the pocket and the entire pipe line heated perfectly.

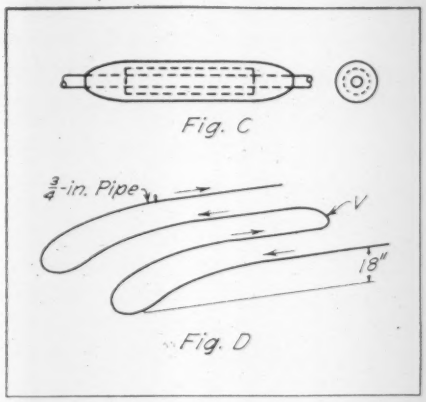


Fig. C (top)—Method used for stopping a leak in a rusty 1½ in. water pipe with a jacket of reinforced Portland cement mortar. Fig. D (bottom)—In one installation it was necessary to place the pipe so that an 18 in. air pocket was formed. The author assumed it would be necessary to have a vent at point "V" but the water pushed the air out of the pocket in operation and the pipe line heated perfectly

Water Tends to Absorb Air

A few months ago I installed a heating system (Fig. E) in my home. The boiler and circulator are in the basement, the open expansion tank is on the floor of the house, and the heating coils are in the crawl space under the floor in order to heat the floor so that it, in turn, will heat the house. The heating system, divided into two circuits, is made up of finned surface on 1¼ in. pipe, about 200 ft of new 1¼ in. pipe, and about 80 ft of old pipe ranging in size from 1½ to 3½ in. This old pipe had been installed in the crawl space about 40 years earlier and was quite rusty but still perfectly sound. Using the different pipe sizes and running the pipe lines over and under the floor sills created a large number of air pockets.

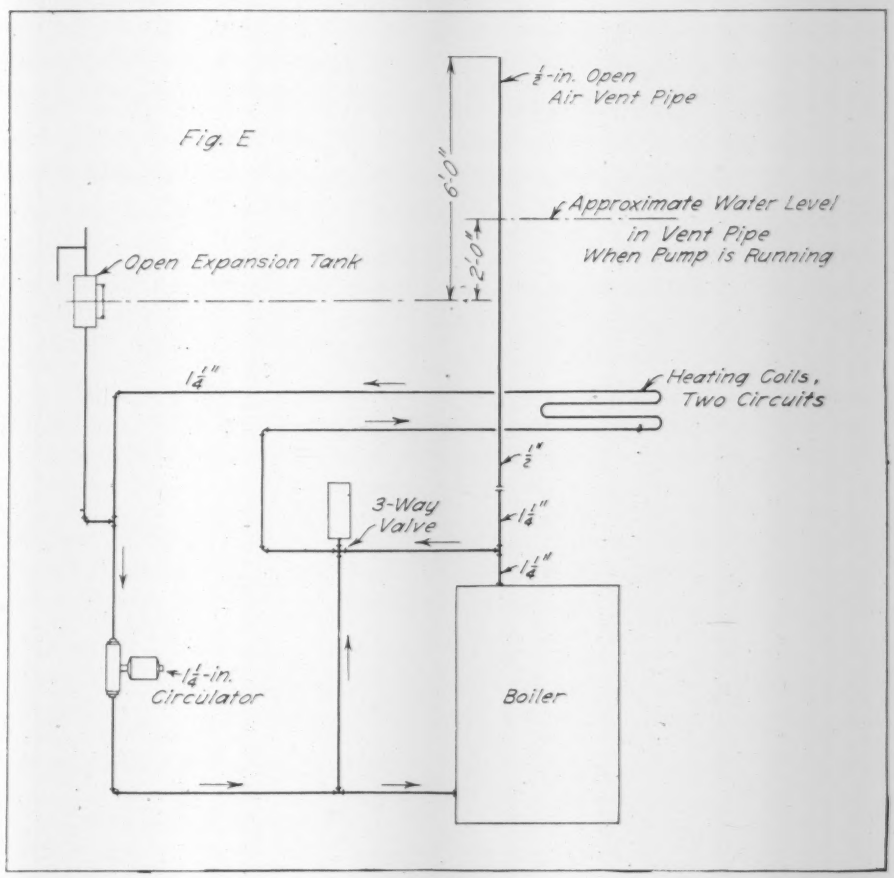
The open expansion tank is connected to the suction side of the pump so that the pump is always under a constant head. An open vent pipe is connected to the boiler so that the air which is liberated in the boiler can escape readily.

The water in the boiler was kept at a temperature of about 130 F and the water circulated through the coils at a temperature of about 110 F. The pump was operated intermittently. When the pump was started after it had been at rest for several hours, a quantity of air had collected near the boiler and was forced out through the vent pipe at such a rate that a small quantity of water, possibly one ounce, was carried to the top of the vent pipe and discharged there.

I believe that this phenomenon can be explained as follows. When 110 F water is flowing through an air pocket it absorbs some of the air and when this water, with its dissolved air, enters the boiler and is heated to 130 F, air is expelled and finds its way to the pipe system above the boiler and to the vent pipe. If this explanation is correct, all air will in time be removed from the pipe system but in the present case the heating season ended too soon after the system had been installed to determine this. During the next heating season, definite data should become available.

This system is the first one in which I left the vent pipe open to the atmosphere; ordinarily, I place

Fig. E—Sketch of simple forced circulation hot water heating system, illustrating some of Dr. Giesecke's comments on venting



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a valve in the vent pipe near the boiler through which the liberated air can be discharged from time to time. In the present system the friction head was less than 2 ft and the open vent pipe could therefore be relatively short. The water level in the vent pipe will vary with the pressure head produced by the circulator.—F. E. GIESECKE, consulting engineer, New Braunfels, Texas; author of the book Hot Water Heating, Radiant Heating, and Radiant Cooling, which was reviewed in the May 1947 HPAC; member of HPAC's board of consulting and contributing editors.

SUPERHEAT CAUSE SCALE ON EVAPORATIVE CONDENSERS?

THE MAY ISSUE of HPAC (pages 80-81) contains an excerpt from a paper on evaporative condensers presented by Ross J. Martin at the Midwest Power Conference. As one who happens to have more than a passing interest in evaporative condensers, I was particularly interested in the statement on page 81, as follows:

"The use of a dry superheating section performs a dual function. First, the temperature of the refrigerant gases entering the main condenser coil will be cooled due to the removal of superheat from the refrigerant and thus the tendency for scale to be formed on the condenser coil will be lessened. . . . "

It would be greatly appreciated if Mr. Martin could give the source of information behind this statement. Is there any actual evidence where the use of a desuperheating coil lessened the rate of scale formation? Is there any reliable test information to prove that the cooling of the superheated gases will, in practice, reduce the amount of scale formation on the top rows of the condenser where we would expect the superheat to exist?

Similar statements to the one quoted above have appeared in advertising literature but there is no evidence, to my knowledge, that desuperheating coils reduce scaling on evaporative condensers; certainly not to any substantial degree. It is, therefore, important that the statement quoted above, originating from such an authentic source, be substantiated or repudiated by presentation of facts so that the users of this type of equipment be not misled.

Scale Thickest Where No Superheat

Examination of many condensers in field operation has shown conclusively that scale tends to form thickest at the bottom of the coil where there is no superheat. The reason for this accelerated scale formation at the bottom of the coil is beyond the scope of this discussion. It is simply evident from actual jobs in operation.

Reference to the temperature of the superheated gas is misleading since it is quite obvious that the tube surface temperature and not the gas temperature affects scale formation. Under the conditions normally found in evaporative condensers, the heat transfer from the superheated gas to the tube wall is so low in comparison to the heat transfer from condensing vapor to the tube wall that the temperature of the tube in the superheated region cannot be greatly higher than in the condensing region.

To my knowledge, the only proved methods for retarding scale formation are:

1) The use of a copious quantity of spray water.

2) Proper distribution of the spray water to insure that all parts of the coil and headers are uniformly covered.

3) The use of a foolproof water bleed arrangement whereby sufficient water is drained off to prevent excessive concentration of minerals.

4) When necessary, in certain localities, the use of chemical treatment.

A desuperheating coil increases the capacity of an evaporative condenser and in many instances this function justifies its use. With the type of evaporative condenser where moisture laden air is drawn through the fan, the desuperheating coil, by heating the moist air, may retard corrosion. These known functions should stand on their own merits without confusing the issue by an alleged but unproved effect on scale formation.—D. D. WILE, chief engineer, Refrigeration Engineering, Inc., Los Angeles.

SELECTING FUEL FOR PLANTS AND BUILDINGS

I HAVE READ over carefully the article on selecting fuel for plants and buildings, by Fred Meyer, published in the June HPAC. The article is very informative and gives a lot of basic facts that are of real value to the engineer.

Mr. Meyer is well acquainted with the problem he discusses and has done an excellent job of organizing and presenting all phases of it.

Articles such as this are of real value to the engineer and Mr. Meyer is to be congratulated on his clear, concise remarks regarding a subject that we, as engineers, are and should be interested in.—LELAND J. MAMER, chief engineer, Evanston Hospital, Evanston, Ill.

EARTH AS HEAT SOURCE FOR HEAT PUMP

I ENJOYED reading the article by B. F. Raber, C. F. Boester, and F. W. Hutchinson on the heat pump and heat transfer from a buried plate, in the March HPAC. The authors' main thesis that one must use a period of several months to have either calculations or experiments along this line be of practical value is certainly to be heartily commended. (In a recent report an attempt was made to base conclusions on a test of this general sort which lasted barely two days!)

There is an apparent misprint in Equation 1, the time Θ belonging in the denominator, but the curves of Fig. 1 have been computed from the correct equation. I seem unable to check the curves of Fig. 2, but perhaps I have overlooked something. A number of points have been checked on the ingenious graphical solution of Fig. 3.

My main comment, however, is along a quite different line. The equations used *apply only to a plate*

held at a constant temperature throughout the operation period. To keep this constant temperature the heat pump would, as the authors compute, have to abstract (or add) heat at a rate some 60 times greater near the beginning of this period than at the end. It is a bit hard to imagine a practical case where such conditions would occur or where calculations founded on such conditions would aid markedly in practical design, even with much averaging and approximating.

In the winter operation of the heat pump the rate of heat transfer from the soil would *increase*, rather than decrease, until midwinter. While this rate would vary from hour to hour or from day to day such irregularities would average out and its value might, to a first approximation, be taken as constant over any one month or even longer period. The *temperature* of the plate, however, would fall more or less continuously from the start of operation, and it is the value of this temperature and its dependence on heat transfer rate in which one is primarily interested, inasmuch as it governs the efficiency.

The simplest adequate treatment which applies here is an elaboration of the Kelvin *heat source* theory. The equation for the temperature of a plate, transferring heat to or from soil on one side only at a constant rate q_p is given, in the nomenclature of the article by

$$t_e - t_p = \frac{2\, q_p \sqrt{\theta}}{\sqrt{\pi k c \rho}}$$

It is possible to derive this equation from Carslaw and Jaeger, Heat Conduction in Solids, page 222, Oxford Press, 1947; or it is given directly in Ingersoll, Zobel and Ingersoll, Heat Conduction, with Engineering and Geological Applications, page 156, McGraw-Hill, 1948.

For a transfer rate of 3 Btu per hr per sq ft the above equation gives the following values for $t_e - t_p$ for the soil considered: For one week or 168 hr, 13.9 F; one month, 28.9 F; four months, 57.8 F. It will be noted that the temperature of the plate falls (or rises in summer) comparatively rapidly; indeed the change is proportional to the square root of the time. This fact would seem to make the plate of less probable usefulness as a heat pump heat source than the long small pipe, as the equation (see Ingersoll, Zobel and Ingersoll, loc.cit., page 152) for the latter shows a much slower rate of temperature change with time. To take account of the change in average transfer rate from month to month it is readily possible to develop either plate or pipe formulas to fit conditions occurring in practice as closely as one wishes.—L. R. INGERSOLL, University of Wisconsin, Madison.

NO HARD AND FAST RULES FOR RADIANT HEATING

W. A. CONNOR's comments on my article, published in "Open for Discussion" in the June HPAC, show once more that no hard and fast rules can be set up for radiant heating installations and that individual cases should be considered individually. I am glad that the example of the ceiling system in a room of 22 ft in height was brought up. This might avoid misunderstanding of my previous statements, which merely meant to point out that in very high spaces floor systems might be more economical in operation. I did not intend to state that ceiling systems would not provide comfort.

As to the lag of systems, my experience is in full agreement with Mr. Connor's statements concerning ceiling controls. However, we have encountered a number of floor systems which have resulted in overrun due to sudden sun influx. It should be noted that the occupants are little apt to complain about temperatures higher than design temperatures, which fact does not necessarily eliminate such temperatures. Also, the influence of sun radiation becomes less important in northern sections of the continent.

As to the floor edge losses, I am in full agreement with Mr. Connor, and can readily visualize that slab edge insulation when carried down deep enough is equally effective as insulation under the floor of the basementless structure. Such effective edge insulation might also well account for the relatively small floor losses of 15 percent. Although this percentage varies very little with outside design temperatures, it varies considerably with floor (or edge) insulation and increases with structures having well insulated walls and roofs.—R. G. VANDERWEIL, Slocum & Fuller, consulting engineers, Boston.

PANEL HEATING WITH HIGH TEMPERATURE WATER

DATA GIVEN IN Table 4 of J. R. Kell's article in the June HPAC on the application of high temperature hot water to panel heating are interesting but should be used with caution. The recommended addition of 50 percent for comfort effect in a room with two exposed walls is startling. Is this an arbitrary figure, or is it substantiated by reliable research? If it has not been well established, then the further small correction of 1 percent per foot of height seems unjustified.

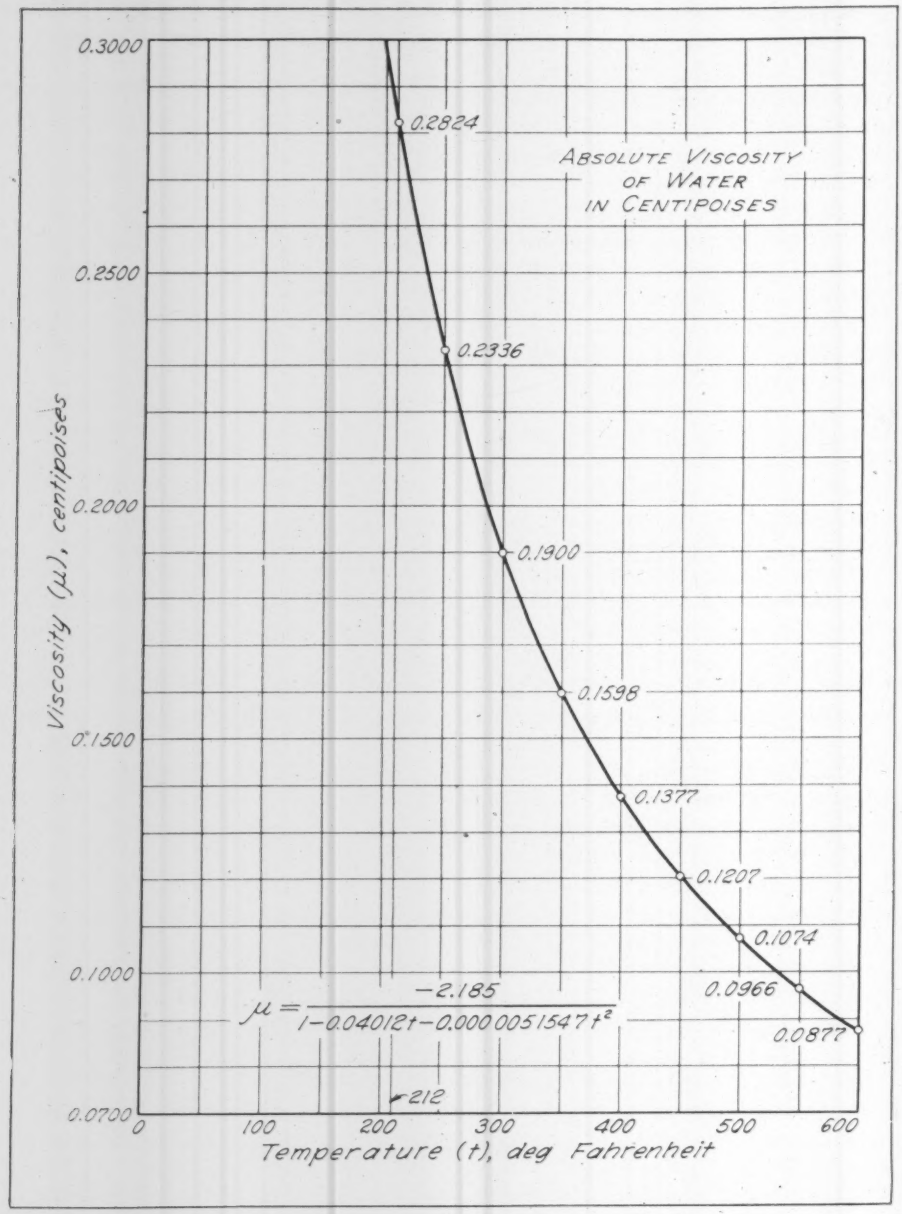
Under typical English design conditions of 30 F outside and 65 F inside temperatures, a system designed from Table 4 with an allowance of 50 percent for heating effect would be able to maintain a temperature of only 54.75 F when the outside design temperature was reached. This seems quite low even for English standards of comfort.

The same data applied to typical design conditions for this country of zero F outside and 70 F inside would result in a system capable of maintaining an inside temperature of 51.8 F in zero weather. Field tests have indicated that the more conventional type of panel heating does not permit an appreciable reduction in room temperature. There is no reason to believe that by materially reducing the panel area and increasing its temperature by 100 F, people can be made comfortable at a 20 deg lower temperature.

As indicated above, the use of a heating effect factor of 50 percent is seriously questioned. A further statement on this subject by the author would be appreciated.—C. M. HUMPHREYS, senior engineer, ASHVE Research Laboratory, Cleveland.

HIGH TEMPERATURE WATER DEVELOPS

DURING THE last 20 years, developments in high temperature water heating systems have taken place in different countries. These developments varied somewhat. In Germany, Switzerland, and Italy the greatest progress was achieved, and complicated installations, using all types of boilers as well as accumulators, were designed. Various types of forced circulation boilers were utilized in these installations. The English development, described by J. R.



Kell in his articles in HPAC, has not yet attained as high a degree of efficiency, in my opinion, as in the countries mentioned. It is important to record that, especially in respect to temperature drops and to pressures applied, the development of high temperature water heating has far exceeded the limits described by Mr. Kell.

The pressure should actually be determined solely on the size of the heating plant. There is no point in installing a 200 lb boiler for a small plant with pipe runs not exceeding 100 to 150 ft. If, however, the area to be covered by the heating system is large and the heat output considerable, it would warrant raising the pressure to 150, 200 or even 250 psi. This is important, because in this way larger temperature drops can be applied, and the resultant reduction in pipe sizes and cost of fittings and valves would more than offset any additional costs due to higher pressure. Low pressure and temperature drops are not economical either for the dimensioning of the pumps, the pipe lines, or the boilers. In more than 20 years experience in designing these systems, I have seldom installed boilers producing high temperature water at 75 or 100 lb pressure. Such low pressures are only used in connection with primary power production. These conditions will be discussed later.

The elimination of steam from a high temperature water system is certainly important and any well designed system must take care of this fact.

Mr. Kell gives a table of the properties of water at high temperatures. In this table he lists the specific heat values as slightly higher than those given by other authors, for instance Aubrey I. Brown and Salvatore M. Marco (Introduction to Heat Transfer), or Keenan and Keyes. The viscosity information he gives seems to be far out of line and varies considerably from most accepted figures. The best review of data on the viscosity of water is given in the paper by G. A. Hawkins, L. Sibbitt, and H. L. Solberg (Review of Data on Dynamic Viscosity of Water and Superheated Steam) published in the ASME Transactions, January 1948. In this paper the authors give a review of 27 investigations on the viscosity of water and steam.

Properties of Water

Based on the formula they recommend, I have calculated the viscosity between 212 and 620 F for water, and I am giving the results in the accompanying graph. The viscosity is rather important for the pressure drop calculation. Based on past experience in designing high temperature water plants, we have become thoroughly acquainted with reductions in pressure drops to be expected in pipe lines carrying fluids at elevated temperatures.

I agree with Mr. Kell that extreme accuracy in selecting the proper pipe sizes should not be over emphasized.

The present designs of radiant heating, which limit to low values the temperature in the floors and in the ceilings, seem to be very practical, and besides this these designs eliminate the possibility of dust accumulation. Our company is working on a special panel heating design applying directly high temperature water in floors and ceilings, and considerable tests are underway to obtain a panel with low surface temperature and still utilize high temperature fluid heat distribution. It may, however, sometimes be practical to utilize heat exchangers in individual buildings.

Our company is very glad to assist any manufacturer or consulting engineer in the design of high temperature fluid heating systems. We will be pleased to answer any questions on this matter.—PAUL L. GEIRINGER, chief engineer, American Hydrotherm Corp., New York City

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Heating Results Depend on Construction Details

The details of construction—including how insulation is put in, as well as many other factors—affect to a large extent the results obtained by the heating, air conditioning, and ventilating services in a building. A "case study" involving a hospital nurses' home illustrates some troubles that can occur

I AM A MEMBER of the board of a semi-charity hospital. (Of course, nearly all hospitals are semi-charitable and cost more to operate than the patients pay.) This hospital had a lovely little white painted frame building for its nurses. It was designed—without compensation—by a good architect who did not supervise its construction. The general contractor who built it probably also trusted his foreman and did not give detailed supervision. The design called for a flat roof, to be used as a sun deck, and there was some idea that this deck might eventually become the floor of a second story.

The basement was excavated at one end to house an oil burning steam boiler and most of the area under the first story was left as a crawl space 2 or 3 ft high, with an uneven dirt floor. The outside walls were of 2 x 8 in. studs on wall plates below the joists so that the air from the crawl space could flow up between the joists and the studs.

No fire stops were placed between the studs, and instead of 2 x 8 in. plates at the tops of the studs, 2 x 6 in. plates were used to carry the ceiling joists. A rough floor was laid on the ceiling joists, then an inch of fibrous organic insulation, and then a watertight composition roof, well sealed with asphalt, was applied. There was a properly flashed parapet around the edges of the roof, having scupper openings through it for drainage to exterior downspouts.

The nurses moved in and were delighted. However, they soon complained that the roof leaked, since water dripped through the white enameled plaster ceilings around the lighting fixtures above the beds. Water fell from the ceiling upon the food in the kitchen. So the superintendent sent for the roofer, who patched and sealed and inspected but could find no puncture. The water persisted in making itself obnoxious and the place commenced to be odorous of rotting vegetation. Finally, my interest was enlisted and I went intensively after that trouble.

I removed the white pine coping above a spot on the parapet. The fibrous insulation was wringing wet, as was all the wood around it. I cut an opening through the roof only to find the same condition, with the joists as wet as if they'd just been fished out of a river. I entered the crawl space with a flashlight, and found the ground saturated with water. There were several little ponds that seemed to have held water for a long time.

I looked around outdoors. The building was not atop a knoll, but neither was it in a valley. The melting snow, however, piled up against the walls and the downspouts spilled directly on the ground close to the walls. The walls were of rather common concrete, by no means the kind that some contractors say will not act as a filter for passage of water. There were no footing drains. (I approach the stage when I wish to shoot every architect who omits footing drains!)

Anyway, a gang of men quickly did all of the following things—and even though this happened several years ago, the nurses still live in their charming white home and are dry and well:

The downspouts were connected to a proper sewer and no longer

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feed frog ponds in the crawl space under the building. Communication by air from the crawl space into the flues between the studs in the walls definitely was blocked off by a "man-mole" with a trowel accompanied by brick and mortar. A slot about 8 in. wide was cut through the roof and through the insulation the full length of the building so as to tap every joist space to the end that breathing could occur to evaporate the accumulated water and to prevent its recurrence.

This slot was covered and provided with weather protection by a continuous ventilator having a water-flashed curb. Proper apologies were made to the manufacturer of the insulation (who had received his quota of passing blame) and to the roofing contractor, who had expended far more dollars than his hoped-for profit, in proving that he had built a watertight cover for the nurses.

All this bears on the cost of fuel for heating buildings. I saw an old three-story building the other day, where good brick walls were furred and plastered—but with the wall flues open all the way from basement to attic, between the furring strips and the lath and the brick. Strong drafts of air were busily wiping away (and throwing it to warm the country) the heat that should have been conserved by horizontal fire stops between the vertical furring strips. This mistake in construction may account for unusually high fuel consumption in many otherwise favorable buildings.

I remember dissuading my family surgeon from buying an old brick home because I found the building was built in this particular way—not to save fuel, but to waste it.

INDUSTRIAL AIR CONDITIONING—

[*Concluded from page 91*]

tions on the same side, which means an even number of rows. Drip pans should be placed under each coil section which is under separate control.

The floor under the cooling coil section should be insulated and treated with a waterproof coating.

Some designers like to have a cooling coil sprayed with water—usually more for cleansing purposes than anything else. In most cases the water is recirculated. Spraying the coils is an extra expense and it should be possible to keep them clean without spraying. Also, spray water may leave a deposit on the coils, which is very bad indeed and results in more harm than good.

As for spraying the coils improving heat transfer, coil manufacturers seem to have different views. One large firm says there is absolutely no difference in coil performance, with the use of recirculating water sprays or with no sprays at all. Another states that with the sprays a reduction of about a degree and a half in wet bulb temperature is attained. So the designer will have to decide which statement to follow.

The single row reheat coil on the down stream side of the cooling coil serves as a tempering coil in the winter and a reheat coil in the summer, when the sensible heat ratio is low. An air bypass may be placed at this coil, especially for winter use when temperatures are above 45 F. Under these conditions even a single row coil is apt to overheat.

It is a good idea to use two modulating steam valves, placed in parallel, to control the steam to the reheat coil. One handles the volume of steam used for winter and the other, much smaller, is for summer reheat use.

A steam grid humidifier is shown on the downstream side of the reheat coil. This type of humidifier if the supply steam is at low pressure and has no odor, is most practical. Many designers use a pan humidifier, with a steam coil immersed in the water.

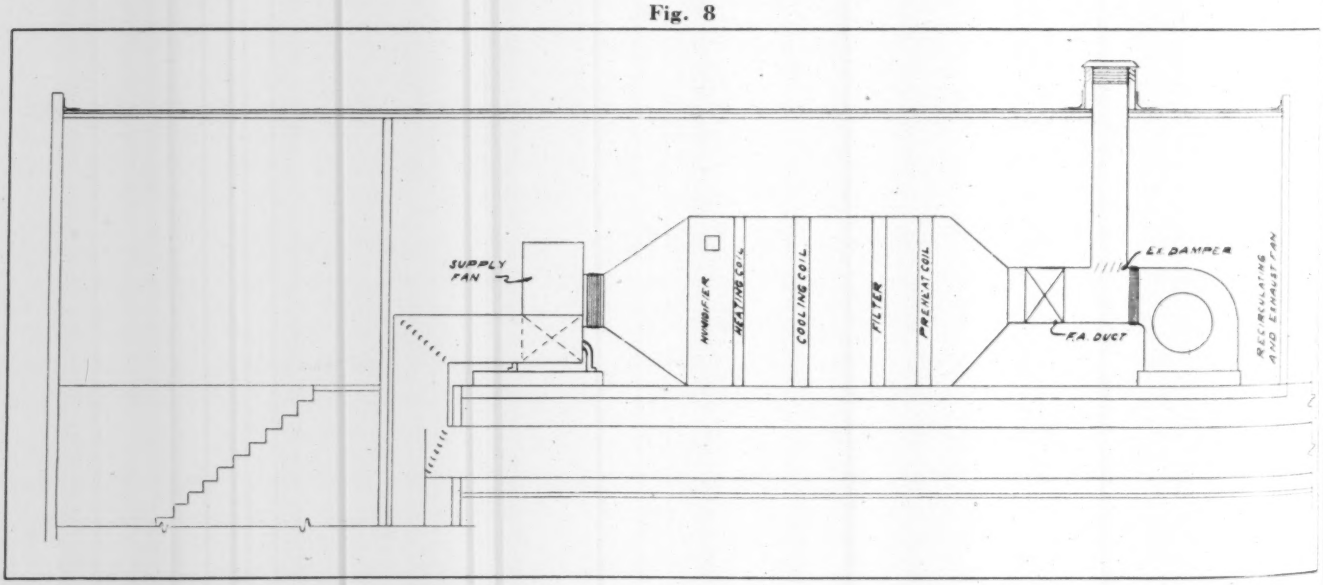
The supply fan is double inlet, double width and must have an airtight intake chamber. It discharges directly downward.

Figs. 5-8 show plenums similar to those of Figs. 3 and 4, except for the use of single inlet fans and the fact that in Figs. 5 and 6 the plenum chamber runs in the opposite direction from the others. With the single inlet supply fan, the plenum casing is brought directly to the intake of the fan, instead of using an airtight intake chamber.

Figs. 7 and 8 eliminate the airtight intake chamber for the recirculating fan as well.

The decision as to use of a built-up casing instead of fan plenum chambers must be made on the basis of size and construction requirements.

Fig. 8



Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Hydraulic Analogue for the Solution of Problems of Thermal Storage, Radiation Convection and Conduction

By Charles S. Leopold*, Philadelphia, Pa.

SUMMARY—The prediction of the actual performance of a space cooling system requires a full consideration of radiation, convection, conduction, thermal storage and time. Since a mathematical solution would be complicated beyond reasonable engineering application, a machine has been constructed for the solving of problems of this type by utilizing the analogy between heat transfer and liquid flow, together with constants for source energy distribution previously determined.

Purpose of the Analogue

In calculations of the cooling load in air conditioning, it has been tacitly assumed that thermal storage may be utilized or neglected according to the designer's wishes. In a conventional air cooling system, however, where the major load is due to artificial lighting or solar radiation, thermal storage of engineering importance occurs even where the cool air supply is at all times adequate to maintain constant room air temperature.

The mathematical solution of heat diffusion problems is cumbersome at best and when, as in this case, radiation, convection and conduction for two or more solids must be considered, the mathematics is complicated beyond reasonable engineering application.

A hydraulic analogue has therefore been constructed for the purpose of solving such problems and thereby providing an insight to the true nature of the cooling load and the behavior of cooling systems.

*Consulting Engineer. Member of ASHVE. Presented at the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, Bretton Woods, N. H., June 1948.

Two Problems

The following problems *A* and *B* are presented to illustrate the analysis of the load and the equivalence of the analogue:

Assume: An infinite interior zone in a multi-story building; no furniture or fixtures; floor construction 10 in. cinder concrete, no furring; entire load is indirect illumination as by silvered bowl lamps; load equivalent 3.4 watts per square foot; ceiling painted with white zinc oxide, floor dark color; air supply uniformly diffused; room air temperature = structure temperature at zero time.

A. Solve for cooling requirements, air and structure temperatures as a function of time when air constantly introduced is of a quantity and at a temperature which would maintain a constant air temperature in the absence of storage. (The usual basis of calculation.)

B. Solve for cooling requirements and structure temperatures as a function of time when the air supply and its temperature are controlled to maintain constant room air temperature. (The usual application.)

Two Answers

Answers as obtained by means of the hydraulic analogue are presented in Figs. 1, 2 and 3.

For problem *A*, based on the usual space cooling *calculation*, the temperature of the room air will drop while the temperature of the floor and ceiling will rise and the *required* refrigeration effect is less than that calculated without taking storage into account even after 14 hours of operation.

For problem *B*, the temperature rise of the structure is greater than for problem *A* and the required cooling effect is considerably less than that available on the basis of problem *A*. The magnitude of these effects is of engineering significance.

Qualitative Justification of the Results

Air is substantially transparent to radiation. Carbon dioxide and water vapor will absorb a portion which, in the subject problem, would not be expected to exceed 10 percent[1]. Opaque solids, in part, reflect and, in part, absorb, depending primarily on the absorptivity of the surface. The part absorbed causes a rise of the surface temperature and this, in turn, causes heat transfer to the air by convection, to other solids by radiation, and into the solid by conduction. Thermal storage or conduction, therefore, will take place until the temperature of the surface is sufficiently above the room air temperature to provide an energy rate of convective exchange, surface to air, plus radiation to other surfaces, equivalent to the rate of radiant energy absorption by the surface.

If, at a given time, there is thermal storage, the cool air supply does not have to remove the entire load (*e.g.*, Problem *B*). If the cool air supply is sufficient to compensate for the entire load, it represents an over-supply for the momentary load and the room air temperature will be depressed (*e.g.*, Problem *A*).

[1] Exponent numerals refer to Bibliography.

Problem Statement for Quantitative Analysis

The factors which must be considered are shown diagrammatically in Fig. 4. Of the energy supply to a bare filament lamp 84.6 percent appears as radiant energy.

The percent of source energy which represents the radiant energy directly absorbed by the ceiling was determined in previous experiments,[2,3] and has been called *Independent Radiant Transfer*, or IRT. Basically, it is the percentage of the source energy which is directly absorbed by the ceiling, substantially independent of normal variations of ceiling temperature but dependent on the ceiling absorptivity for radiation from the source which, in this case, is a filament at approximately 4840 F. An approximate table of values of IRT

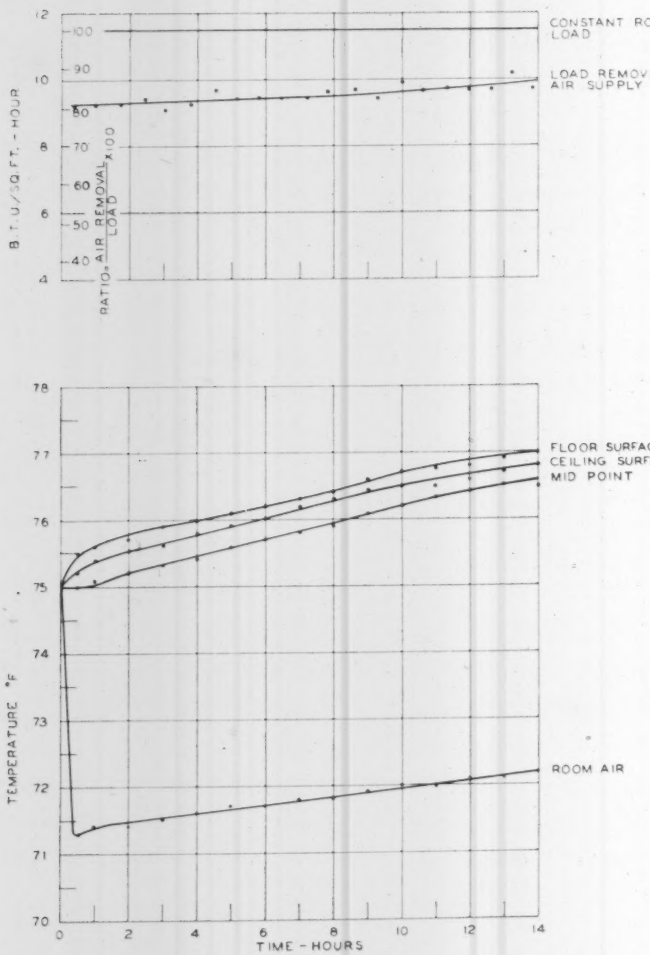


Fig. 1—Solution of Problem A

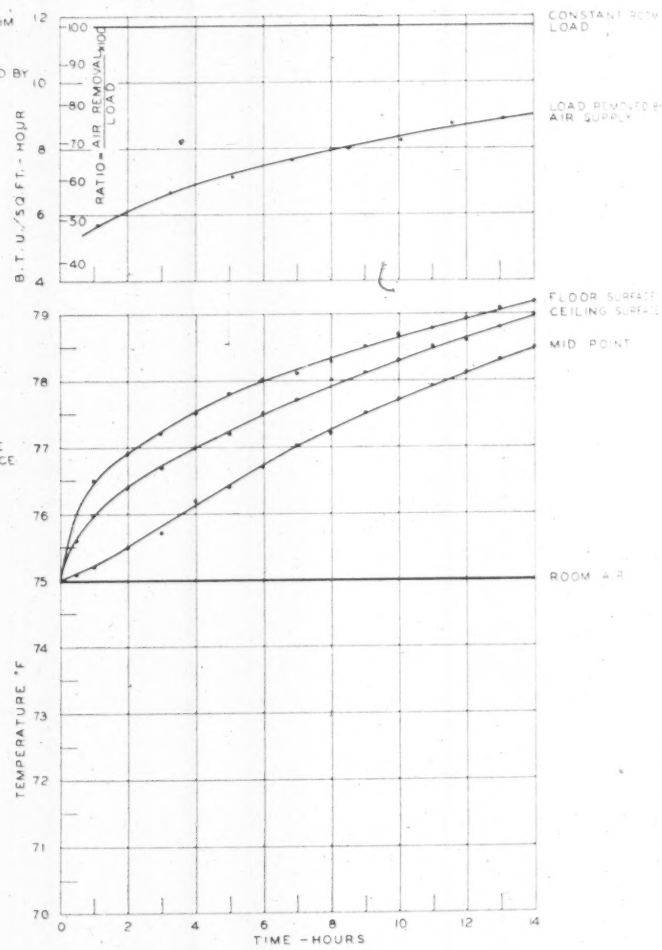


Fig. 2—Solution of Problem B

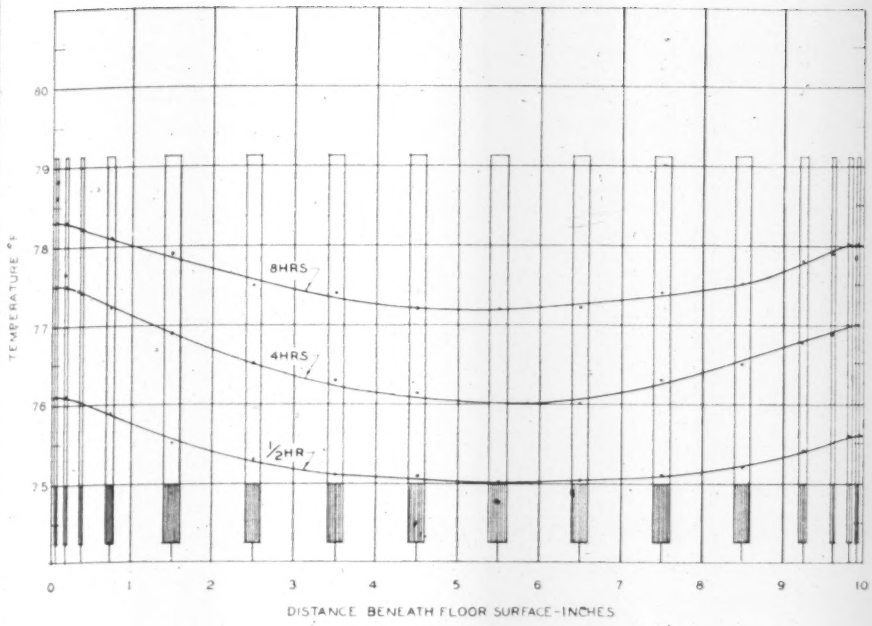


Fig. 3—Temperature Distribution in Floor and Ceiling for conditions of Problem B

for various types of lighting systems is shown in Table 1. The test method used in obtaining these data was such that radiation to the ceiling from hot surfaces of the lamp or fixture is included in the IRT.

The distribution of energy in fluorescent and filament lamps is shown in Table 2. If a large component of radiation is directed downward toward surfaces of high absorptivity, there will be an important effect due to radiation, even though the IRT to the ceiling approaches zero.

For the solution of the problem on the analogue, quantitative information is required as follows:

Total radiation from source—manufacturer's data.

Radiation absorption in the luminaire—estimated at 10 percent of lamp input.

Radiation absorption due to CO_2 and water vapor—estimated as 10 percent[1].

Values of IRT—test data[1,2]. Thus, for the silvered bowl lamp, the total radiant energy ultimately absorbed by the room surfaces is:

$$(84.6\% - 10\%) \times 90\% = 67.1\%$$

By test, 20 percent of total source energy is absorbed by the ceiling (IRT). By difference, 47.1 percent is absorbed by floor and 100 — 67.1 = 32.9 percent transferred to room air.

To maintain constant room air temperature, the cooling required by the air supply at any time is the sum of A + C + D, Fig. 4. Since C and D depend on surface temperature, it is necessary to follow the thermal distribution in the slabs.

The analysis of the problem, as diagrammed in Fig. 4, is novel in that from a known, experimentally determined source energy distribution, the resulting temperature distribution in air and structure is determined as a function of time.

Even with this simplifying approach, a strictly mathematical solution would be difficult and laborious, involving simultaneous differential equations, definitely a task not to be lightly undertaken, if at all.

Thermal and Liquid Equivalence

For liquids in laminar flow within a tube (Reynolds number less than 2000) and for unit time, Volume = Conductance × Head. For approximate values of heat transfer by convection, Heat Transfer = Conductance × Δt, and for low temperature radiation, where Δt is small, Heat Transfer = a Constant × Δt.

Thermal storage graphically,[4] and by analogy, electrical,[5] and hydraulic,[6] has been represented by considering the solid as divided into layers of thickness determined by the required accuracy.

In the hydraulic analogue, each layer is represented by a vertical tube corresponding to thermal capacity and a submerged tube corresponding to conductance. Conductance of the layer may be considered as lumped before or after storage, or divided one-half before and after.

A wall can then be represented as in Fig. 5.

The problem statement shown in Fig. 4 implies that the radiation from the lamp to and absorbed by the ceiling, and that reflected to and absorbed by the floor, are sub-

Table 1—Percent Independent Radiant Transfer (IRT)

Ceiling Paint	Regular[a]	Heat Absorbing[b]
Clear Filament Lamp	9	17
Silvered Bowl Lamp	20	35
Four Tube Fluorescent Fixture	12	21
Single Tube Fluorescent Fixture	2	10

[a] Sherwin Williams No. 22125—White Zinc Oxide
[b] Sherwin Williams No. H-3079

Table 2—Distribution of Energy for Fluorescent and Filament Lamps

		Fluorescent Direct-Single Tube—40 Watts	Fluorescent Semi-Indirect 4 Tube—40 Watts	Filament 300 Watts
Mfgr's. Data	Visible	8.2 Watts	32.8 Watts	38.4 Watts
	Infrared & Ultraviolet	10.6 Watts	42.4 Watts	215.4 Watts
	Conduction & Convection	21.2 Watts	84.8 Watts	46.2 Watts
Measurement—Auxiliaries		15.5 Watts	31.0 Watts	
Total		55.5 Watts	191.0 Watts	300.0 Watts
Percent Radiation		$\frac{8.2 + 10.6}{55.5} = 33.9$	$\frac{32.8 + 42.4}{191.0} = 39.3$	$\frac{38.4 + 215.4}{300} = 84.6$

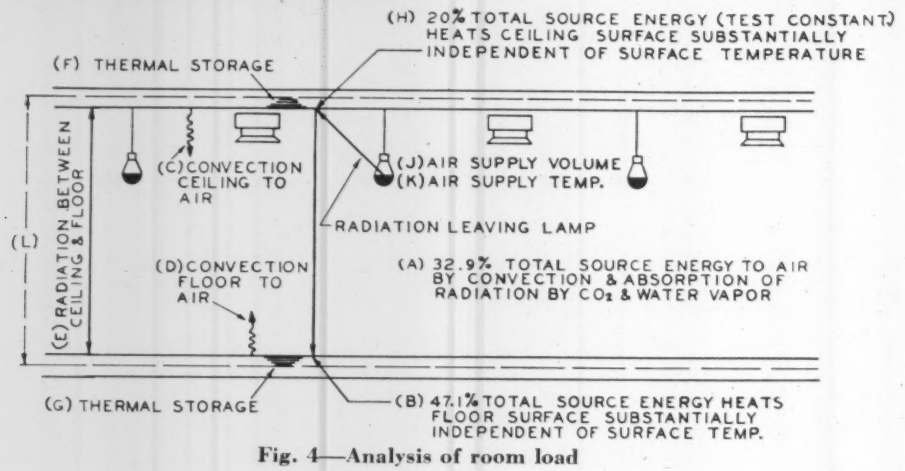

(H) 20% TOTAL SOURCE ENERGY (TEST CONSTANT) HEATS CEILING SURFACE SUBSTANTIALLY INDEPENDENT OF SURFACE TEMPERATURE
(F) THERMAL STORAGE
(C) CONVECTION CEILING TO AIR
(J) AIR SUPPLY VOLUME
(K) AIR SUPPLY TEMP.
(L)
(E) RADIATION BETWEEN CEILING & FLOOR
RADIATION LEAVING LAMP
(D) CONVECTION FLOOR TO AIR
(A) 32.9% TOTAL SOURCE ENERGY TO AIR BY CONVECTION & ABSORPTION OF RADIATION BY CO_2 & WATER VAPOR
(G) THERMAL STORAGE
(B) 47.1% TOTAL SOURCE ENERGY HEATS FLOOR SURFACE SUBSTANTIALLY INDEPENDENT OF SURFACE TEMP.

Fig. 4—Analysis of room load

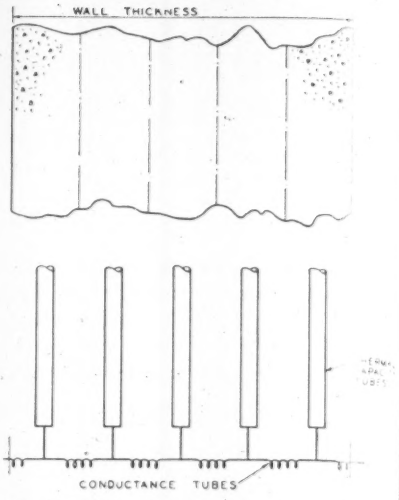


Fig. 5—Analogue representation of wall thermal capacity and conductance

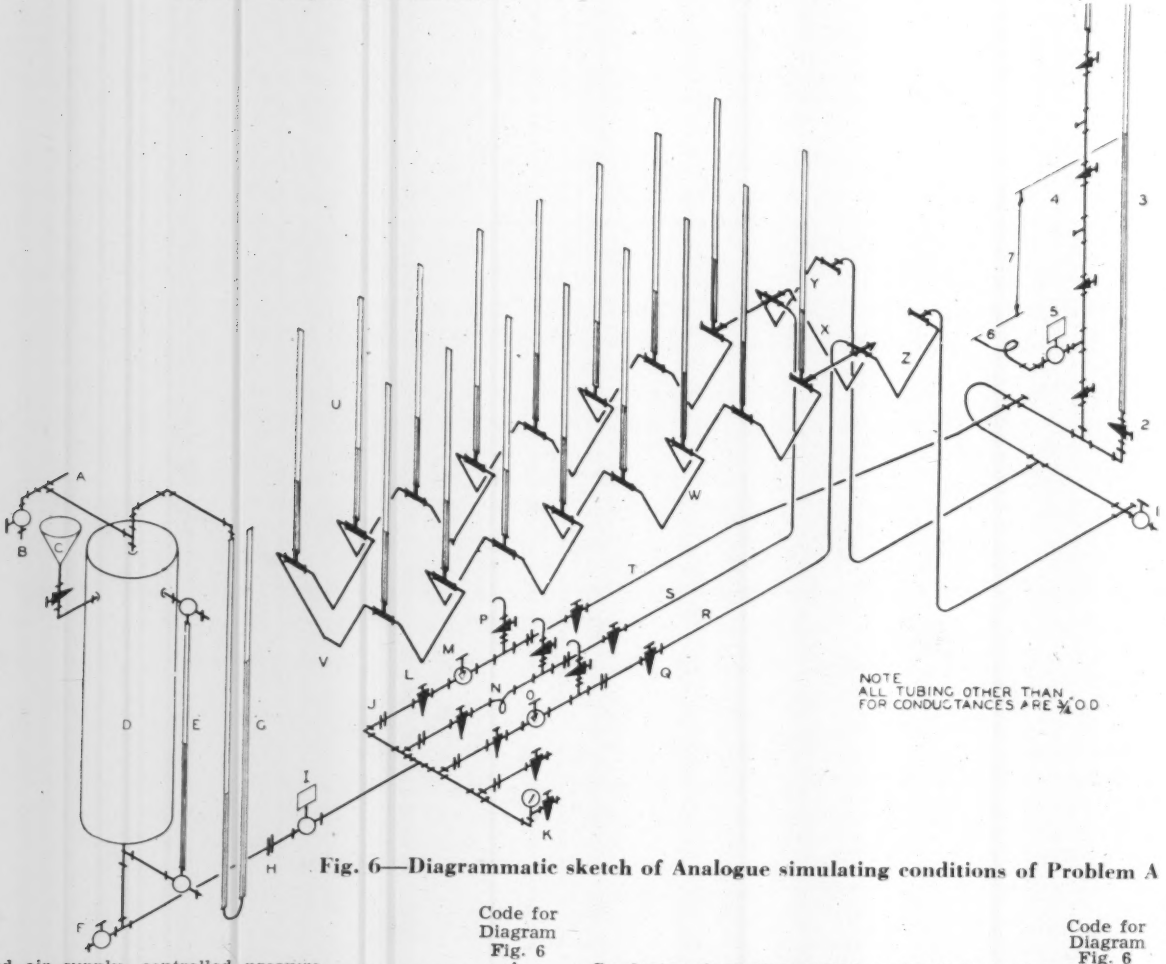


Fig. 6—Diagrammatic sketch of Analogue simulating conditions of Problem A

	Code for Diagram Fig. 6
Compressed air supply, controlled pressure	A
Air relief, used also to establish minimum air flow	B
Filling funnel	C
Storage tank	D
Gauge glass	E
Drain Valve, normally closed	F
Mercury column	G
Strainer	H
Motorized valve	I
Couplings (4)	J
Air relief	K
Gate valves, normally open (4—one spare allowed for additional wall)	L
Needle valve	M
Flattened restrictor tubes	N
Needle valve	O
Test cocks (3) normally closed	P
Gate valves (3) normally open	Q

	Code for Diagram Fig. 6	Corresponding Items Fig. 4
Conductor simulating radiation absorbed by floor	R	..... B
Conductor simulating radiation absorbed by ceiling	S	..... H
Conductor simulating flow to air	T	..... A
Thermal storage tubes	U	
Conductance tying midpoints of floor and ceiling	V	
Conductance tubes for wall elements	W	
Conductance for radiation between floor and ceiling	X	..... E
Conductance for convection, ceiling to air	Y	 C
Conductance for convection, floor to air	Z	..... D
Drain valve, normally closed	1	
Gate valve, normally open	2	
Tube simulating thermal capacity of air	3	
Tube paralleling the glass tube (3) and used for convenience in attaching bleeders	4	
Motorized valve	5	
Conductance representing pounds of air times specific heat	6	Constant X

stantially independent of ceiling and floor surface temperatures. They could be represented by liquid flow from a positive displacement pump but sufficient accuracy is obtained by substituting the more convenient method of forcing liquid through a calibrated restriction with an initial pressure high enough to minimize flow variations due to the expected variations in head occurring in the storage tubes of the analogue.

The air supply in weight or volume can be simulated by a conductance arranged to bleed liquid from the system. The supply air temperature can be simulated by the level at which this conductance is allowed to discharge, as:

For unit time, for liquid: Volume = Conductance × Δ head

For unit time, for heat transfer: Thermal units = Conductance × Δt

Weight of air = a Constant × Conductance.

The model for the selected test is shown diagrammatically in Fig. 6. Photographs of the analogue, as constructed, are presented in Figs. 7, 8 and 9.

The ceiling and floor are represented by half thickness as, by symmetry, in a multi-story building, conditions at their mid-points are the same. They are, therefore, connected by a tube (V) representing the sum of one-half conductance of the innermost ceiling and floor laminations.

For this problem:

1 Btu = ½ cu in.
1 F deg = 1 in. head
1 hour = 1 min
Unit Area = 1 sq ft of floor surface

Operation of Apparatus

The liquid at the start is at the same level in the vertical tubes representing structure and room air. There is a supply of liquid in the storage tank D Fig. 6 and the air pressure in the storage tank is adjusted to provide the design flow through the restrictors M, N and O. Taps P are provided for calibration of the restrictors and are closed for the run. The electrically operated valves I and 5 are opened and the clock is started simultaneously. Readings of all levels follow at 1 minute (equivalent to 1 hour) intervals.

The procedure for Problem *B* differed from Problem *A* only in that the conductance 6, Fig 6, was replaced by a manually operated valve which was used to keep the liquid level in the air tube at constant height. The effluent was caught in a beaker resting on a balance and was weighed at suitable intervals.

Data for the design and calibration are presented in the Appendix.

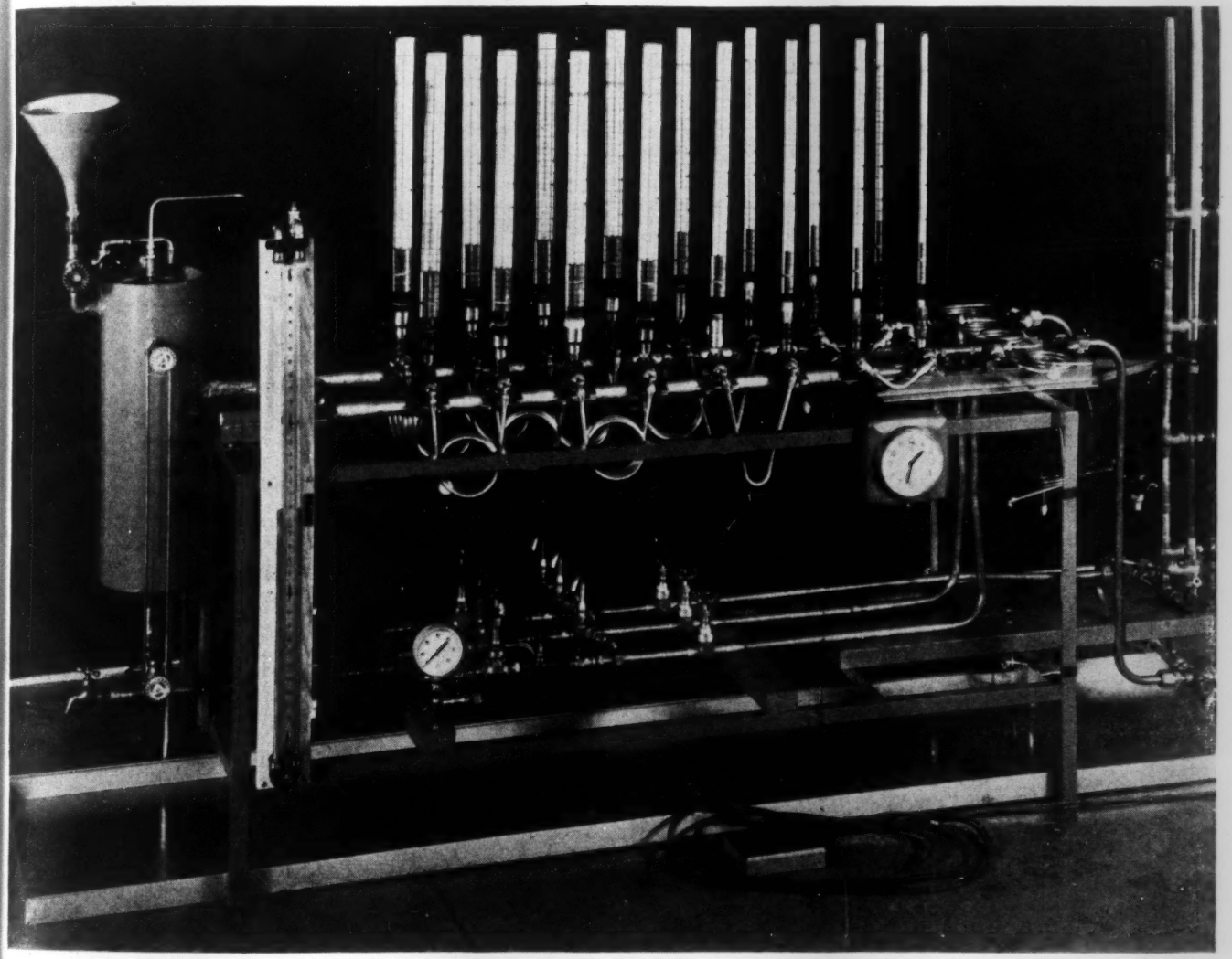


Fig. 7—Photo of Analogue

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Discussion

For the problem chosen, the stress was placed on radiation from a high temperature source. Radiation for which small temperature changes are significant (low temperature radiation) appears only as a secondary effect in the form of radiation between ceiling and floor. Actually, most loads in a cooling system have a radiant component, whether they be a wall warmer or cooler than the surfaces *seen*, a person, or a source of illumination—solar or artificial.

Wherever the transfer of radiant energy occurs within a real enclosure, the justification for the use of a combined surface conductance coefficient, convection plus radiation, is open to serious question.

For the simple case of a wall somewhat warmer than the surface it *sees*, the combined coefficient cannot be used to express the thermal gain of the air. Since the air is substantially transparent to radiation, it is necessary that the radiant energy be absorbed by a surface, and thermal storage must result until complete equilibrium is reached. The time factor in approaching equilibrium is of engineering significance. Even though the temperature changes in the walls *seen* are small, the effect of thermal storage may still be proportionately large.

In calculating the actual work required of a space cooling system at any instant, it would appear advisable to consider separately convection, radiation, conduction, and thermal storage.

Consideration of the mechanism of thermal storage in this type of problem indicates that in recooling the structure the heat transfer is primarily that of convection only and the rate of cooling is relatively slow as compared with the rate of heating where radiation effects are predominant.

Conclusion

The analogue has proved useful in analyzing and predicting the actual functioning of space cooling systems.

Typical of the problems being investigated, but not reported here, is that of the effect of design temperature difference, supply air to room air, for three differently loaded rooms in the same zone. The supply air temperature is *thermostatically* controlled for the normally loaded room and the deviation of room air temperature noted for rooms 50 percent and 150 percent loaded. Results are obtained simulating five successive days of use with a predetermined period of precooling or after-cooling. Results are obtained for various percentages of radiation from the source.

Other problems include the effect of permitting a planned temperature rise in room air, the effect of walls, the determination of optimum methods and periods of precooling, the behavior of panel cooling systems, and control requirements for systems where time or load changes are a factor.

Acknowledgments

Acknowledgment is made to Time Life, Fortune and Architectural Forum who financed the experimental work.

Appendix

For the portion of this analogue which represents thermal diffusion

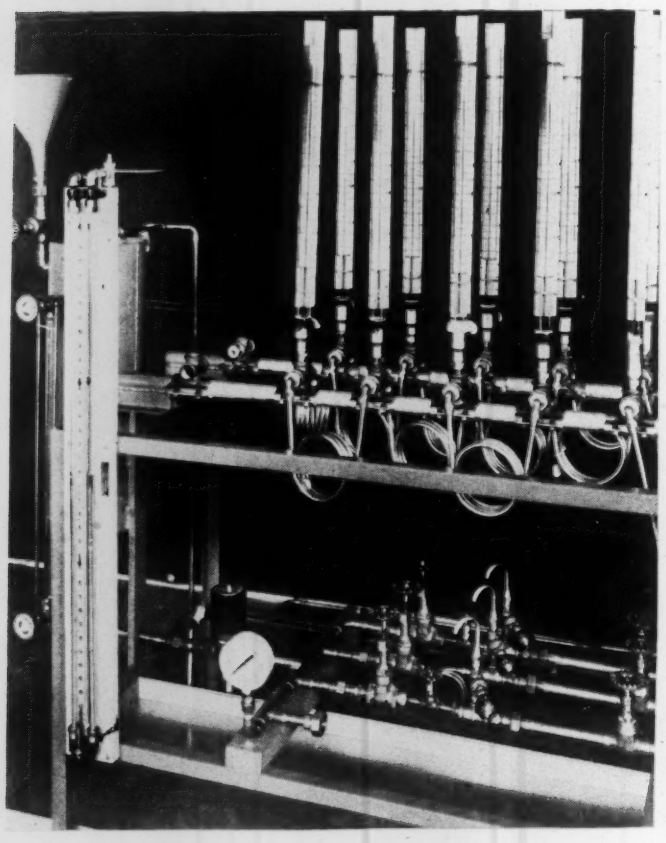

Fig. 8—View of left end of Analogue

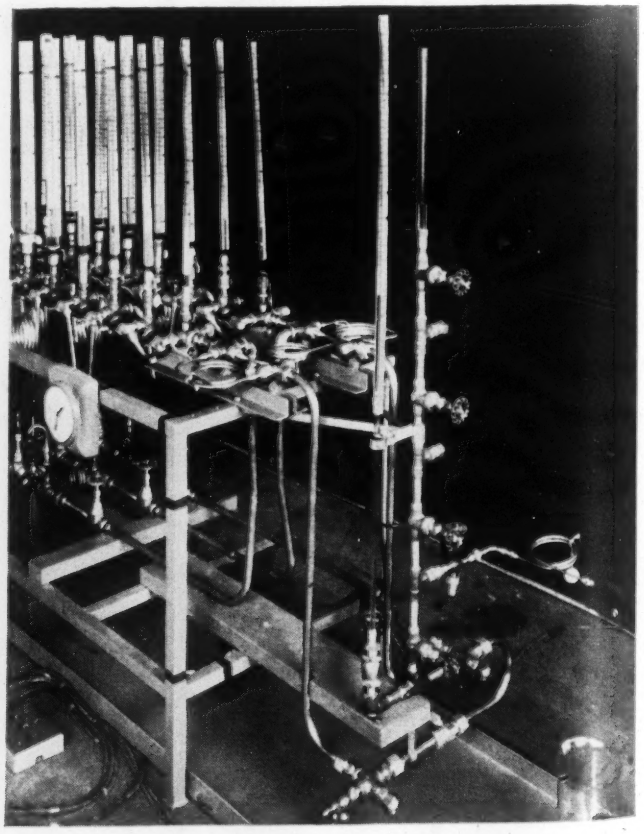

Fig. 9—View of right end of Analogue

the design is similar to that used for the *Hydrocal*[6] of A. D. Moore, who used water as the working liquid. In his apparatus the low viscosity of water necessitated the use of fine bore tubes. The relatively large change of viscosity of water with temperature made advisable a constant temperature bath for the conductance tubes. Mr. Moore's admirable candor in describing the difficulties in development (principally those due to algae and corrosion) plus subsequent chemical discoveries enabled the author to proceed to the final design without any serious complication.

Liquid

For this analogue, the selection of a silicone liquid (Dow-Corning Corp. DC20) of 20 centistokes kinematic viscosity permitted a Reynolds number of approximately 60 while utilizing a minimum tube diameter of ¼ in. OD, maximum diameter ½ in. OD, wall thickness 0.032 in. The change of viscosity with temperatures is less than for water and within the required accuracy of these experiments a water bath for conductances was not required. The flow correction is 1.2 percent per Fahrenheit degree by test. The silicone used has shown no signs of supporting the growth of algae or causing corrosion in the glass, copper, and steel apparatus.

Conductors

The required length of coiled tubing representing conductances could readily be approximated.

Each conductance, completely assembled with elbows, was calibrated with the apparatus shown in Fig. 10.

Storage Tubes

The vertical glass tubes used to represent storage were calibrated for actual bore. The tubes representing the thermal storage were selected to simulate smaller layers near the surface in order to accentuate the temperature gradient. They were mounted on the pipe support with a clamp in order to permit adjustment of capacity by tilting.

Joints

Mastic joints between the glass and copper did not prove dependable and were, in part, replaced with

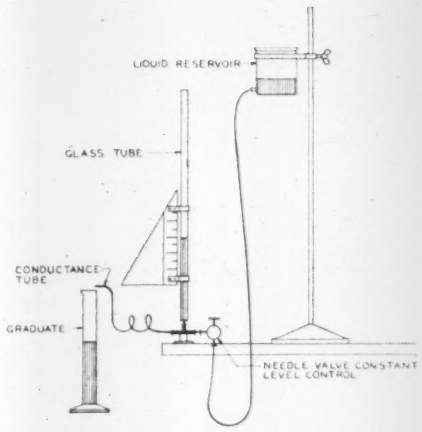

Fig. 10—Apparatus for calibrating conductances

successive layers of rubber tubing.

Cement was not used on threaded joints. Where difficulty was encountered, the pipe thread was wrapped with cotton thread.

Check of Thermal Diffusion

The floor and ceiling sections were checked as a whole by disconnecting them from the apparatus and solving a problem in which a 5 deg temperature head was constantly imposed on the ceiling surface, while a measurement was made of the time required for a 3 deg rise at the floor surface. This time was compared with the calculated time by means of values obtained from a Gurney-Lurie chart.[7] The calculated and measured values were in agreement within an error of 5 percent. The deviation was substantially constant but no correction was made as the values of thermal capacity and conductance for cinder concrete would show larger variation.

Restrictors

In designing restrictors M, N and O (Fig. 6) which must maintain proportional flow for a wide range of pressures, it was found that the flow for the floor and to the air could be controlled by a needle valve and still yield an approximate first power (1.02) relation of flow to differential pressure. When the flow to the ceiling was limited to 10 percent, a needle valve did not provide proportionality but a flattened 3/16 in. tube, approximately 20 in. in length, as shown at N (Fig. 6) and in the photograph, Fig. 8, proved satisfactory.

A fine strainer was inserted just before the electric valve in order to protect the small openings in the restrictor tubes.

Cleaning

A catch pan was installed beneath the model in order to recover any silicone which was spilled in manipulating the apparatus. In scraping from the pan, it accumulated some dirt and acquired a straw color. Clarification was readily effected by filtering through charcoal.

Air

Air elimination offered surprisingly little difficulty. It was found that by applying the lips to each tube in turn, and blowing until the liquid was in the bottom of the tube, the liquid could be accelerated in the conductance tubing to the point where the air was pushed on to the next vertical tube. After initial elimination, there is no sign of air unless the model is emptied.

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PURDUE STUDENT BRANCH ORGANIZED

A group of students at Purdue University, West Lafayette, Ind., was granted a charter for the Indiana Chapter Purdue Student Branch by the Council. The Charter was presented by C. F. Boester at a meeting, April 23, which was attended by the Officers of the Indiana Chapter. A meeting on May 19 was held at the Mechanical Engineering Building with Prof. W. T. Miller presiding, and the By-Laws and Rules were discussed after which an election of officers was held. The following student members were elected: R. G. James, chairman, B. E. Petry, vice chairman, D. M. Long, secretary, D. E. Blue, publicity chairman, J. H. Miller, coordinator.

The installation of officers was held on May 21 in the presence of 40 student members and seven guests. An introductory address concerning the work of the Student Branch was given by Prof. W. T. Miller, and I. W. Cotton of Indianapolis, President of the Indiana Chapter, welcomed the new Purdue Student Branch and assured the student members that the chapter would take a strong personal interest in all of its activities.

Mr. Cotton then introduced A. V. Hutchinson, Secretary of the Society, who outlined the aims and activities of the ASHVE, and then presented the record books for the Student Branch officers.

Then R. G. James, presiding, expressed the appreciation of the Student Branch for the interest of the Society and the Indiana Chapter. Following the introduction of the Student Branch officers, a technical discussion was held. J. D. Bottorf, graduate student, gave an illustrated talk on the Analytical Phase of the Heat Pump, followed by presentation of the Experimental Phase of the Heat Pump by W. Trent, also a graduate student.

Carl Boester, Member of Council, presents Charter to Purdue Student Branch. *(l. to r.)* S. E. Fenstermaker, I. W. Cotton, Prof. W. T. Miller, T. R. Davis, W. R. Fenstermaker, Mr. Boester, G. B. Supple

ILLINOIS PAST PRESIDENTS' NIGHT A GREAT SUCCESS

The Illinois Chapter honored the past presidents of the Chapter on April 12 and designated this meeting Past Presidents Night. The large attendance indicated that it was an enjoyable reunion for many of the older members. The Chapter past presidents from Chicago on hand for the occasion were:

S. R. Lewis	C. W. DeLand
C. F. Newport	R. E. Hattis
G. W. Hubbard	J. H. Milliken
John Howatt	J. J. Hayes
A. B. Martin	S. I. Rottmayer
E. P. Heckel	Irving Brooke
H. G. Thomas	E. M. Mittendorff
A. G. Sutcliffe	C. E. Price
J. J. Aeberly	A. O. May

O. J. Prentice

In addition, the following now located outside of Chicago were present: J. A. Cutler, Milwaukee, Wis.; L. S. Ries, Oberlin, Ohio; J. R. Vernon, Milwaukee, Wis.; J. S. Locke, Minneapolis, Minn.

Illinois is the oldest Chapter in the Society and was organized in 1906. The original petition was signed by 14 members of the Society during the Semi-Annual Meeting in Chicago, July 19, 1906.

The present membership of the Illinois Chapter makes it the second largest Chapter in the Society.

MORTGAGE REDUCTION FUND GROWS

With the latest contribution from the New York Chapter of $1.00 per member, the total contributions to the Mortgage Reduction fund amounts to $21,543.32. At present cash on hand is $2764.70 and the balance due on the mortgage as of June 1, 1948, is $10,500. Payments to the extent of $24,500 from members' contributions and from Society funds have been made against the total mortgage principal of $35,000. Following is a detailed statement of contributions of Chapters and individual members to the Mortgage Reduction Fund:

FROM CHAPTERS	Amount
Atlanta	$ 447.00
Central New York	740.00
Central Ohio	122.00
Cincinnati	730.00
Connecticut	538.00
Golden Gate	371.00
Illinois	2,132.00
Indiana	30.00
Iowa	103.00
Kansas City	350.00
Manitoba	233.00
Massachusetts	827.80
Memphis	104.65
Michigan	806.00
Minnesota	721.00
Montreal	366.20
Nebraska	70.00
New York	2,439.68
North Carolina	70.00
North Texas	133.48
Northern Ohio	2,086.68
Oklahoma	75.00
Ontario	897.00
Oregon	145.00
Pacific Northwest	122.00
Philadelphia	1,437.23
Pittsburgh	235.00
Rocky Mountain	55.00
St. Louis	292.50
South Texas	642.00
Southern California	901.50
Utah	225.00
Virginia	31.31
Washington, D. C.	277.50
Western Michigan	415.00
Western New York	721.50
Wisconsin	483.04
	$20,377.07
Other	1,166.25
Total Contributions (6-1-48)	$21,543.32

The Mount Washington Observatory

America's Original Mountain Weather Station

By Donald H. Chapman*, Durham, N. H.

SUMMARY—Mount Washington is a great natural laboratory where scientific experiment has been carried on with remarkable success. In this paper, the physical environment of the Mt. Washington Range is first reviewed, with emphasis on the climate found at the summit. The history of the Mt. Washington Obervatory, the first mountain weather station to be established in America, is recounted. Finally, a summary of some of the experimental work carried on by the Observatory is given and a suggestion is offered as to how the environment of Mt. Washington might aid materially in future experimentation in Heating and Ventilating Engineering

Since the days of the first world war when the Norwegian school of meteorologists developed the method of predicting weather called *air mass analysis*, those interested in the science of meteorology have been more aware than ever before of the importance of the vertical structure of the atmosphere. In order to sample the air aloft, captive balloons or kites were used long ago. Later, airplanes ascended through the atmosphere obtaining observations with specially installed recording instruments. Still later, the much less expensive method of sounding the upper air with radiosondes was devised. Radiosondes are tiny weather stations with miniature broadcasting sets which, when lifted through the air by helium-filled balloons, relay information regarding the condition of the air to specially tuned sets on the ground.

In studying the condition of the atmosphere, it is of the utmost importance to have a dense network of weather stations established over the country. At such stations, observations are made of temperature and atmospheric pressure, wind direction and velocity, sky conditions, and a host of other weather elements. These observations, made simultaneously at all stations, are sent to central collecting points by teletype, telegraph and radio, and relayed to all who are interested. From such observations, weather maps are constructed and weather forecasts are prepared daily, as well as hourly.

* Associate Professor of Geology, University of New Hampshire.

Presented at the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, Bretton Woods, N. H., June 1948.

Mt. Washington Station in Continuous Operation Since 1932

Weather stations established on mountain summits are especially worthwhile in studying the vertical structure of air because they are permanently established high altitude points at which continuous records may be made. If the land surrounding the mountain on which the weather station is located is flat and low, then the station is even more valuable. Such, in the main, is the situation of the Mt. Washington Observatory which now has been in continuous operation since 1932.

Mt. Washington is the highest summit in the White Mountains, and lacks only a few hundred feet of being higher than any mountain in the United States east of the Rockies. Together with the rest of northeastern North America, Mt. Washington was buried thousands of years ago beneath the Great Ice Sheet. The rounded character of the summit is to be attributed at least partly to scour as the rock-shod ice moved across it. As the ice sheet was disappearing, ice still lay thick and deep in the valleys while Mt. Washington and other high summits protruded through the surface like rocky islands in a sea. During this phase, due to freezing and thawing every night and day, the summit became covered with rough and angular, frost-split rock fragments.

Gradually the climate grew warmer and as the ice slowly melted, various species of arctic plants which had migrated southward during the ice age, began to return to the White Mountains. As sub-arctic climates lasted longer on the high mountains the plants migrated upslope with climatic zones, and today on some of the higher plateaus or *lawns* surrounding the cone of Mt. Washington proper a variety of these relic plants may be observed. Such is the nature of the *Alpine Gardens* on the east slope of the mountain, north of Tuckerman Ravine[1].

Climatic and vegetation zones thus persist on the slopes of the high summits of the White Mountains and this is particularly true on Mt. Washington since it is the highest in the group. Such zoning of vegetation is easily observed during the course of an ascent of the mountain, whether one climbs one of the numerous, well-marked trails, maintained by the Appalachian Mountain Club, or drives his car from the Glen House to the summit along the eight-mile long gravel-surfaced toll road, or whether he

[1] Exponent numerals refer to References.

ascends directly from Bretton Woods by the famous Cog Road, first of its kind in the world. Timber line lies between 4200 and 4800 ft, and is somewhat higher on the eastern slopes because of the prevailing westerly winds. A good summary of the vegetation of Mt. Washington is presented in Antevs' book[1] on the Alpine Zone of the Mt. Washington Range.

Almost all of New Hampshire has a climate which is called by climatologists *Humid Microthermal*. This means that the winters are relatively severe, the summers short and rather warm and the rainfall adequate and equally distributed throughout the year. Thus at the outset, let it be said that similarities, rather than differences, are the outstanding features of New Hampshire's climate. However, the higher summits of the White Mountains have a climate which has been described as *tundra* because of prevailingly lower temperatures. Increasing altitude also brings greater precipitation, but the seasonal distribution remains essentially the same.

Data on the climate of New Hampshire are available from various sources, chiefly from the Climatological Division of the U. S. Weather Bureau. Some phases of the climate of the state have been recently reviewed by the author[2], and a few salient facts from this summary are pertinent in connection with the present paper.

Factors Affecting New Hampshire Climate

Of the factors which influence the variety of New Hampshire's climate, latitude is of little effect, for New Hampshire is after all a very small state. Altitude is far more important because air which is forced up along a mountain slope is adiabatically cooled and may eventually reach its dew point. Clouds thereupon form and rain or snow may follow. Consequently, because of altitude differences alone, a cloudless day in southern or central New Hampshire may be a cloudy or showery day in the heart of the White Mountains.

Air drainage is another factor which is noticeable to a visitor. The cooler air along the higher mountain slopes, because of its greater density, tends to flow down the slope, and is sometimes distinctly noticeable at night as a *mountain breeze*. Nights, both in summer and winter, are much colder in the valleys than on the upper slopes of the mountains when cyclonic winds are not blowing.

Another powerful influence that introduces variety into New Hampshire's climate is the paths followed by travelling cyclones or low pressure systems. Storms cross the country from west to east and commonly travel down the St. Lawrence valley just north of New Hampshire, or along the coast just southeast of the state. Such storms, with attendant winds and rains, make the weather of New Hampshire variable from day to day and introduce prediction difficulties which make weather forecasters gray-haired at an early age.

Standing as a sentinel along the paths of such storms, Mt. Washington protrudes upward into the storm systems. These are rarely very deep, but are commonly very wide in diameter. Air moving along its habitual course toward the storm centers encounters the Mt. Washington range and is forced to rise to pass over the obstruction. Funneling of air over the top of Mt. Washington, like any fluid in a Venturi tube, is partly responsible for the fact that the Mt. Washington Observatory has the questionable distinction of having recorded the world's highest surface air velocities, 231 mph (April 12, 1934).

Data from 42 weather stations in New Hampshire, together with 15 additional ones from adjacent states, were assembled recently by the author in an attempt to show graphically the month-to-month shift of precipitation over the state[3]. One item from this study which is certainly of interest here is that the driest portion of the state lies in the northern Connecticut River Valley, northwest of the White Mountains. Mt. Washington, with a normal annual precipitation of 77 in. contrasts markedly with 35 in. for Bethlehem, only 19 miles away. The winter season, when most of the rain falling in the state is of cyclonic origin, is furth[er] rmo[re] the driest part of the year [i]n th[e] northwestern corner of th[e] stat[e]. There must be a causal relat[ion]shi[p] between this *dry* spot and th[e] pos[i]tion of Mt. Washington itse[lf]; it [is] strongly suggested that the uppe[r] Connecticut Valley is a true *rain shadow* in the lee of a topo[graph]ic obstruction which through adiabatic cooling squeezes most of the atmospheric moisture out of the air before it reaches the Bretton Woods-Bethlehem-Littleton area. If this be true, then it is necessary to revise an earlier concept that most of the rain which falls in New Hampshire is brought in from the west by the prevailing westerlies. It must be concluded that a considerable portion flows over the state from the ocean side.

On the other hand, in summer with maximum influence of convectional rain, rainfall distribution is more uniform throughout the state and the *rain shadow* is much less significant. Daytime cumulus cloudiness in the mountains likewise is a maximum at this season of the year. How many people in Boston or other nearby cities, awakening to find a cloudless Sunday, have hurriedly made plans for an automobile trip through the mountains only to discover by the time they arrived at noon that the summits were completely swathed in low-lying clouds? Many are the people who have *climbed* Mt. Washington by cog road a dozen times without ever having a decent view from the summit! Such persons would do well to remember that if they would have good views from the top, they should be on the summit early in the morning; or better yet, spend the preceding night there. Nor are the best views, for that matter, to be obtained the first day after a rain storm. The second day, though usually more hazy, generally will be less cloudy, due to less turbulence in the atmosphere by that time.

C. F. Brooks[4] has pointed out that while Mt. Washington may not have the worst weather in the world, yet it does not lag very far behind. This investigator has listed four factors which best describe the severity of a cold climate. These are (1) the penetrating qualities of the wind, (2) the lowness of the temperature, (3) the amount of snow

and (4) the occurrence of freezing fog

Mt. Washington Wind Velocities Reach 200 mph

There seems little question that maximum gust velocities on the summit of Mt. Washington reach the vicinity of 200 mph, the highest velocity recorded by any rotation-type anemometer. Such a wind exerts a force of approximately 80 lb per square foot of surface, compared with 20 lb per square foot for the maximum hurricane winds in Boston. Furthermore, winter is the windiest season on *The Mountain*, as it is familiarly called. Wind velocities *average* 55 mph for the months from December to March, inclusive, and when one considers that this figure is an average of troughs of low velocity as well as high crests, it is not hard to understand how wind velocities over 100 mph were recorded for 385 hours during the period 1932-39 inclusive. Hurricane winds, or winds of 75 mph or greater, occur on half the days of every month from December through April, and in the month of March, windiest of all, such winds are likely to occur on 2 out of every 3 days.

Those who first ascend Mt. Washington in summer are often badly fooled about the temperature to be expected. Even though in the valley the day may be hot, wraps must be worn on the summit, where temperatures are commonly 25 and sometimes as much as 40 deg below the concurrent valley temperatures. The two most important factors controlling *sensible temperature* are air temperature and wind velocity. Severely cold winter weather is made to feel even colder if a high wind is blowing at the same time. Everyone realizes how easy it is at home to misjudge the temperature of a cold winter morning if the wind is not blowing. Usually under these circumstances, one factor of sensible temperature (low air temperature) is at least partly offset by the other factor (low wind velocity). On Mt. Washington, just the reverse is true, for the lowest temperatures on *The Mountain* occur almost always with high northwest winds. Thus, while the first day or night of a new cold spell is commonly the coldest on the summit, temperatures are usually lowest in the valleys on the second night after the arrival of such Arctic air.

The records of the Observatory show that snow falls on Mt. Washington every month of the year. In winter, forms of precipitation other than snow are not common on *The Mountain*. As suggested earlier, much of the precipitation which falls on Mt. Washington is probably arriving from the southeast. This in part accounts for the depths of snow in Tuckerman Ravine where it sometimes *exceeds* 100 ft. Another factor which accounts for such prodigious quantities of snow in the ravines east of the summit is the fact that strong northwest winds often blow snow off the mountain into those ravines from which it cannot escape except through melting.

Even at very low temperatures, much of the moisture which composes the fog or clouds that hang over the summit is liquid. Such liquid particles come in contact with intensely cold objects such as rocks, sides of buildings, radio towers and weather instruments. Instantaneous freezing results in thick deposits of white rime which grow rapidly in a direction *into* the wind. Brooks[4] cites the case of rime growing 3 ft long on the Yankee Network Radio Tower on Mt. Washington during several days of high wind and freezing fog in August, 1940, and as much as a 6 ft depth of rime has been known to grow within a single night.

The weather on the summit of Mt. Washington is far more severe than that on any other summit in eastern North America. The conditions on Mt. Mitchell in North Carolina do not begin to compare with those on Washington, for temperatures there are approximately 20 deg higher and winds only two thirds as strong. No one has made a record of the weather conditions in the Shickshock Mountains of the Gaspé or in the Torngat Mountains of Labrador, but Brooks[4] believes that in neither of these two areas is there the same combination of extreme cold, high humidity and excessively high wind velocities. On Pikes Peak, Mt. Rainier and elsewhere in the west, it is believed that conditions approach but certainly do not surpass the severity of the weather on Mt. Washington. Even the conditions reported from the Antarctic are no worse than those on Mt. Washington. Brooks concludes that if there are mountains with worse weather than Mt. Washington can lay claim to, the conditions on them have not yet been recorded.

Within such an environment of severe weather conditions, the Mt. Washington Observatory was established and now has been in continuous operation since November, 1932. But the present Observatory is not the earliest attempt to establish a weather station on this mountain summit. In his history of Mountain Meteorology, Robert G. Stone[5] asserts that the first attempt to make a continuous set of meteorological observations on any American mountain summit was that of Nathaniel Noyes who recorded the weather at the then newly established summit hotel on Mt. Washington during the summer months of 1853 to 1859. Prof. C. H. Hitchcock, Dartmouth College, then State Geologist, with the aid of materials contributed by the U. S. Signal Service, began a series of observations on Mt. Washington on November 13, 1870. The next year the Signal Service took over the project officially. The story of the difficulties encountered by this party of intrepid scientific observers is thrilling and fascinating. One of the most interesting phases of this account is the many stories that were being circulated in the 1870's concerning the difficulties that the observers were having in keeping the fires going in stoves at the summit. The high wind velocities sweeping over the mountain created such abnormal drafts in the stoves that in spite of everything, fires burned out. This occurred in spite of seven separate draft controls that are reputed to have been installed in the stove pipes and chimneys! Incidentally, two years ago when the Tip Top House was being outfitted for winter occupancy, the walls were filled with loose *mica* insulation. When the high winter winds began, the loose *mica* was sucked out of the walls

into the room by the strong draft created by the fires, and the workers in that building are said to have spent a good deal of their time, each day, in sweeping up loose *mica* from floors, desks, tables and chairs! The heater eventually installed in the Tip Top House two years ago was fully twice the capacity recommended by the engineers, and now is just sufficient to heat the building comfortably. Unfortunately, in spite of other summit weather stations that were opened in the meantime, the Signal Service and the Weather Bureau which was its successor, became increasingly dissatisfied with the results obtained, for they did not seem to assist a great deal in making weather predictions. Stone says that the reason was that the science of meteorology was not, at that time, developed far enough to establish an appreciation of the significance of upper air and mountain weather data. The old observatory on Mt. Washington was thereupon closed in 1892 and no data were assembled from this summit for the next 40 years. In 1932, the Mt. Washington Observatory, as we know it today, was established. The credit for this goes largely to Prof. C. F. Brooks of Harvard's Blue Hill Observatory, Joe B. Dodge, manager, Appalachian Mountain Club's hut system, and to Henry S. Shaw, Exeter, New Hampshire. After a plea by Dodge, the New Hampshire Academy of Science, in May, 1932, voted $400 toward the first year's observational work. During the summer, men worked feverishly to assemble supplies and equipment for the project, and in November, 1932, a staff of four began work. Once the station had been established, it was possible to interest others to continue the project year after year. Eventually the Weather Bureau saw the importance of the station in its work, and funds were granted from that source. Funds have recently been supplied by the State of New Hampshire, members of the Observatory Corporation, the United States Weather Bureau, the Appalachian Mountain Club, the New Hampshire Academy of Science, and by contract research with several firms.

Difficulties Encountered in Gathering Weather Data

As may well be imagined, the making of meteorological observations on the summit of Mt. Washington is extremely difficult and often even dangerous. New techniques have had to be devised and some special equipment designed to stand up under the severe climatic conditions outlined earlier. Anemometers and wind vanes had to be specially installed to withstand high winds and heated to counteract the tendency for formation of rime on their surfaces. The high winds made snow drift so bad that ordinary rain gages were useless. Rain was blown by the high winds so nearly parallel to the surface of the mountain that records at first proved very poor. A complete description of observing technique can be found in the 10th Anniversary Number of the Observatory News Bulletin[6].

The Mt. Washington Observatory has proved of great value not only to the Weather Bureau in its weather predictions, but in a host of other ways. Henry S. Shaw was interested in the project from the start because of the opportunity the establishment of the station might offer for experimentation in ultra-high-frequency radio work. The radio research that has been carried on from that time up to the present is considerable. In 1941, the Yankee Network built a frequency modulation station on the summit and the 90 ft tower serves as a landmark to travelers who view the mountain from miles away. Besides the broadcast of frequency modulation radio programs, the Yankee Network Station has continued its valuable contribution in experimental work of various kinds.

A great variety of other research has been and is being carried on either by members of the Observatory staff or by institutions, industrial firms, or research concerns in the observatory building and in other structures upon the summit alloted to them from time to time.

As early as 1905, S. P. Fergusson carried on a series of experiments in which he compared the conditions on the summit with those observed in the free air over Owl's Mountain, N. H., by using kites to which instruments were attached. These experiments were continued after the establishment of the Observatory in 1932. His work showed that the mountain itself introduced into the atmosphere of the vicinity variables of temperature, humidity and wind velocity.

Early experiments in ultra-high-frequency radio reception were carried on by Shaw, Bent, Pickard and McKenzie and proved the value of Mt. Washington since it stands high and isolated. From it lines of sight of great distance can be utilized. For a while, the world's long-distance record for high-frequency radio reception was held by this group who succeeded in establishing contact between Mt. Washington and Melrose, Mass., and eventually even Blue Hill in Milton, Mass.

A great deal of work was carried on during the war, not all of it of meteorological nature. For instance, the Armed Forces tested equipment for use under sub-arctic and arctic conditions and for a time there was a tent encampment on Home Stretch Flat. At another time, anti-aircraft equipment was checked at the summit.

Some of the experiments carried on in connection with the work of the Observatory had an important bearing on the results of V. J. Shaefer of the General Electric Co., Schenectady, N. Y., culminating in the first production of snow in natural atmosphere by planned experiment[7]. In 1943, tests were initiated on Mt. Washington to discover the cause of snow static which was causing so much trouble in planes flying through such precipitation. While the experiments on Mt. Washington were reported as being *not too successful*, according to Schaefer, they did help to check results obtained at Schenectady, and they aroused the interest of General Electric in the problems of icing. In 1944, aircraft icing was the subject of investigation for the Materiel Command, and by 1945 it was possible to show that a relationship existed between the atmospheric phenomena and the experimental observations. In 1946, a supercooled cloud was *seeded* with CO_2 at the Observatory and snow was observed to fall and the cloud

to dissipate. Further experiments along this line by Clark, Gould and others have proved successful.

Research Done on De-Icing Airplanes

Probably the best known of the research projects carried forward on the summit of Mt. Washington is the problem of serious icing of airplanes[8]. Since it was essential that experiment prove the effectiveness of any device for de-icing which was being devised, and as clouds which would simulate icing conditions are manifestly difficult to manufacture in the laboratory, it was only natural that the experiment be brought to the clouds. Mt. Washington, often bathed in fog for days at a time, was an ideal setting for such experiments. Beginning shortly after 1938, the program has been aimed at the discovery of meteorological factors not ordinarily observed which determine whether or not serious icing will occur on aircraft. This group of investigators received a considerable amount of publicity because the project was popularly described as one of *fog sampling*, and public fancy was delighted at imagining a group of scientists stationed on the summit with empty bottles stretching out their arms to catch the fog as it drifted by! Questions which have been related to this study include, according to Arenburg of the Blue Hill Observatory staff, the measurement of the liquid water content of cloud masses, the distribution and size of the fog or cloud droplets, the structure and physical property of rime and ice, the development and testing of all sorts of de-icing equipment, measurement of wind velocity and turbulence and of course a study of the meteorological conditions attending serious icing conditions. The measurement of the liquid water content of fog presented many difficulties because as fast as rime accumulated on the collecting apparatus, the stream lines of air flowing about the collector were disturbed, introducing unknown variables. At last, a rotating spindle covered with blotting paper was devised, and this allowed the ice or rime to accumulate symmetrically regardless of wind direction or velocity. Results prior to 1940 showed that the liquid water content in freezing fogs varied between 0.1 and 1.6 grams per cubic meter of air, with a maximum frequency at 0.5, while the density of samples showed two maxima, one at 0.25 grams per cubic centimeter for powder rime and one at 0.75 grams per cubic centimeter for solid ice. Arenburg states that this is due to the transition in form from powdery rime in which all the air spaces are connected to solid ice in which air space is limited to isolated bubbles. Whether or not solid ice forms, depends upon the freezing rate of the liquid droplets, for if the freezing time is long enough, a second droplet will fall upon the first, coalesce with it and force out the trapped air. The transition point is important because it will determine the strength of the rime or ice and the relative ease with which the deposit may be dislodged from the plane's wing. Since the amount of rime or ice that may form on a plane's wing is related to the drop size distribution, a study of this latter factor is equally important.

A prominent rubber company occupied space near the Observatory several years, with its equipment mounted on the water tower which stands at the geographical summit. Three phases of its research included the adhesion of various types of ice to rubber, neoprene and metal surfaces, the tensile strength of ice and the observation of the behavior of *boot* type deicers during severe icing conditions. Their work has been valuable because there are some conditions of rime and ice formation that simply cannot be reproduced in the laboratory so that exposure to the free air is absolutely essential. Aircraft flying through such conditions experimentally are subject to a considerable hazard and, furthermore the length of any such experiment with a plane in flight is limited by the extent of the freezing fog. But the laboratory on the summit of Mt. Washington can operate steadily 24 hours a day.

Between October, 1946 and September, 1947, the Harvard-Mount Washington Icing Research Project was carried on at the summit, with Harvard University the prime contractor with the Air Materiel Command[9]. Observations were made to determine such quantities as the icing rate, the quality and density of the ice and the mean effective size of the droplets responsible for icing. The instrument used was a refinement of the earlier ones, and consisted of a rotating rod on which was mounted a series of six cylinders of size varying from 3 in. to $\frac{1}{8}$ in. in diameter. Exposure to clouds under icing conditions causes a more or less uniform coating of ice to form on these rotating cylinders. The relative amounts collected on the separate cylinders indicate the *mean effective drop diameter*. "When the small cylinders have considerably more catch in proportion to their size than the large ones, the droplets are small, for the small drops have so little inertia they must go with the wind around the large cylinders"[10]. Other devices used during these experiments included the *drop-ranger*, the *Icingometer*, the *Snow catcher* and a pressure tube anemometer. W. E. Howell carried on studies which show that the physical state of the clouds is the most important factor controlling icing conditions, rather than the weather pattern. According to Howell, there is considerable promise in improving predictions of icing conditions through predicting the physical state of the clouds. In addition, statistical studies have been made possible by the continued assemblage of data from the summit station which today easily constitute the world's most complete file of weather data from a mountain top.

During the past year or two, the Tip Top House has been occupied by the Aeronautical Ice Research Laboratory, a private contractor experimenting for the Materiel Command. The Quartermaster Corps has a *Copper Man* at the summit on which it is testing various types of clothes for their efficiency in keeping out the cold. The *Copper Man* is mounted on the railroad trestle whenever the conditions seem to warrant its exposure.

Thus the work at the Mt. Washington Observatory continues and valuable services are rendered to a

great number of institutions and individuals. One phase of research on *The Mountain* has not, up to the present, been exploited to its limit. The Observatory is a natural laboratory for heating and ventilating engineering where there may be encountered combinations of weather circumstances that are rarely met with elsewhere. Testing of equipment under conditions of combined high winds and driving rain, thick frost and snow covering, and especially of high wind, low temperature and high insolation could be carried on, it would seem, with considerable success.

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WALTON AT STEVENS

Dr. H. N. Davis, president, Stevens Institute of Technology, Hoboken, N. J., has announced the appointment of Charles W. Walton, Jr., as director of the Department of Buildings and Grounds of Stevens Institute, and of R. M. Jones as assistant director.

Mr. Walton, who assumed his new duties on June 1, has been a member of the Central Engineering Department of the U. S. Rubber Co. since 1942. From 1934 to 1942, Mr. Walton was chief mechanical engineer for Rockefeller Center, Inc., New York, where he was in charge of the maintenance of heating, ventilating, plumbing, air conditioning and refrigeration in the various buildings.

For five years previous to this, Mr. Walton was assistant to the chief engineer of the Technicolor Motion Picture Corp., Boston, Mass.

Mr. Walton was graduated from Stevens Institute in 1920 with an M.E. degree. He has been active in the ASHVE, having joined in 1934, and in the *American Society of Refrigerating Engineers*.

Mr. Jones has been associated with Stevens research projects since 1942. Here, he did sound research in connection with the National Defense Research Committee, then, when the war was over, he went on to Damage Control Research for the U.S. Navy, also at Stevens. Following his graduation from Stevens in 1938, with an M.E. degree, he spent two years as a plant operator for the Nantucket, Mass., Gas and Electric Company, and later served in a similar capacity for the Portland, Maine, Gas and Light Co. Mr. Jones is a member of *ASME*.

NEW LABORATORY MEASURES PRESSURE LOSS

Prof. L. G. Miller, head, Department of Mechanical Engineering, Michigan State College, East Lansing, Mich., has announced that the Jackson & Church Co., Saginaw, Mich., is the first company to completely rate its furnaces by laboratory tests, and to make the results available to users.

Acting as a consultant, Professor Miller instituted a long series of tests to determine exact pressure drop through the unit, with and without filters. The exact information regarding the performance capabilities of each unit, as determined from the tests, coupled with characteristic fan data, gives the designer of heating or drying plants accurate data on pressures available for the duct resistance.

Professor Miller added that laboratory testing by Jackson & Church company engineers under his direction is introducing new accuracy into furnace construction and that he had been authorized by Jackson & Church to extend an open invitation to engineers, architects, educators, installers, and anyone affiliated with the warm air heating industry to visit and inspect this modern laboratory.

John R. Allen Memorial Library

The Committee on Research of the ASHVE gratefully acknowledges the following gifts to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory in Cleveland.

Industrial Health Engineering, by Allen D. Brandt, Gift of Allen D. Brandt.

Heating and Ventilating Engineering Databook, Clifford Strock, Editor, Gift of Clifford Strock.

The Aerologist, 1926-1936. Gift of Pierce Timmis.

Air Sanitation and Industrial Ventilation, by W. N. Witheridge. Gift of W. N. Witheridge.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields by authors and others will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

Theory of the Ground Pipe Heat Source for the Heat Pump

By L. R. Ingersoll* and H. J. Plass**, Madison, Wis.

SUMMARY—An analytical theory of the flow of heat from the earth to buried pipes is developed from the Kelvin heat source theory. An equation is included for determining soil temperature at any point following a given period of operation.

Tables and curves facilitate solution of problems involving heat transfer from the earth to pipes in heat pump installations.

Of the three common sources of heat for the heat pump—water, air, and the ground—the last is the most commonly available. Heat is usually extracted from the ground by means of buried pipes, and considerations of efficiency require that these should not run too low in temperature. Accordingly it is highly desirable, as has been pointed out,[1] to have an analytical theory of the flow of heat from the ground into such pipes. One would like to be able to calculate the temperature of the pipe as dependent on its size, rate of heat absorption, thermal constants of the soil, and time since the start of operations. Most of the existing theory, such as that of Allen,[2] is founded on the assumption of steady-state conditions of temperature, which do not apply here except in special circumstances. A somewhat similar problem is that of the cooling of concrete dams by embedded pipes, and for this the elaborate theory of Kingston[3] is available, but its application to the heat pump problem might be a bit involved.

The following elaboration of the Kelvin[4] heat source theory is offered as a relatively simple treatment of the problem. If heat is obtained from an infinitely long permanent line source of heat (*i.e.*, constant rate of heat emission), or sink (negative source) in an infinite medium (*i.e.*, soil) at an initial uniform temperature T_o, then the subsequent temperature at any point in the medium is given[5] by the equation:

$$T - T_o = \frac{Q'}{2\pi k} \int_X^\infty \frac{e^{-\beta^2}}{\beta}\, d\beta$$

$$= \frac{Q'}{2\pi k}\, I(X) \qquad (1)$$

where

$$X = \frac{r}{2\sqrt{\alpha t}}$$

T = temperature in soil at any selected distance from the pipe, Fahrenheit degrees.
T_o = initial temperature of soil, Fahrenheit degrees.
Q' = heat emission of pipe (negative for absorption), Btu per linear foot per hour.
r = distance from center line of pipe (this applies to the surface of the pipe or to points several feet away), feet.
k = thermal conductivity of the soil, Btu per (hour) (square foot) (F deg per foot)
α = thermal diffusivity of the soil = $k/\rho c$.
ρ = density, pounds per cubic foot.
c = specific heat, Btu per (pound) (F deg).
t = time since start of operations, hours.
β = variable of integration.
e = Naperian base of logarithms.

Values of the integral $I(X)$ (see Equation 1) for various values of $X = \dfrac{r}{2\sqrt{\alpha t}}$ are listed in Table 1.

Table 2 shows values of $T - T_o$ at various distances from a line source emitting heat at a rate of 1 Btu per (hr) (linear ft) after various periods of operation. Table 2 was computed by means of values of the integral listed in Table 1.

Equation 1 is exact only for a true line source, but it may be applied with negligible error, after a few hours of operation, to the small (2 in. diameter or less) pipes in actual use in most heat pump installations. For larger pipes (*e.g.*, 4 in. to 8 in.) and for periods less than a few days an error is involved, which, however, can be calculated. It is assumed that the pipe is long enough so that all heat flow is perpendicular to its length, *i.e.*, radial.

The use of Equation 1 and Tables 1 and 2 will be illustrated by solving a number of examples:

Example 1. A long pipe, 1 in. OD, buried vertically in moist high-conductivity soil (k = 1.2, c = 0.45, ρ = 102, α = 0.0261, all foot, pound, hour units) at an initial temperature T_o = 50 F, absorbs heat at a rate of 20 Btu per (hr) (linear ft). What would the temperature be at the surface of the pipe in contact with the soil (neglecting the temperature drop through the wall of the pipe) after one month or 731 hr of operation?

Solution. Substitute r = 0.0417, α = 0.0261, and t = 731 to find the value of $\dfrac{r}{2\sqrt{\alpha t}}$ = 0.0048. Using this value for X in Table 1 the value of the integral $I(X)$ is found as 5.06. Then, from Equation 1, $T - T_o$ = —2.66 × 5.06 = —13.4 deg, so T = 36.6 F. The same result is obtainable at once from Table 2. The curves of Fig. 1 have been calculated in this way and the value of 36.6 F may be read off at once from the upper curve. If the temperature is wanted a foot away from the center of the pipe it is readily obtained either from Equation 1 or from Table 2 with the result $T - T_o$ = —5 F, or T = 45 F.

Example 2. Calculate the expected temperature in a 4 in. OD pipe under the same conditions as

* Professor of Physics, Department of Physics, The University of Wisconsin.
** Assistant in Physics, Department of Physics, The University of Wisconsin.
[1] Exponent numerals refer to References.
Presented at the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, Bretton Woods, N. H., June 1948.

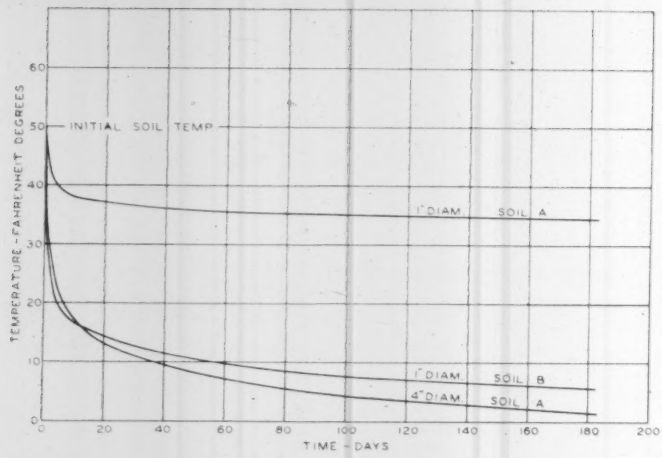

Fig. 1. Temperature at surface of isolated pipes of different diameters in different soils.[a]

[a] Both sizes absorb the same amount of heat per (hr) (unit of surface area of pipe); for 1-in. pipe, 20 Btu per (ft) (hr), for 4-in. pipe, 80 Btu per (ft) (hr). For thermal constants of the two soils see Table 2.

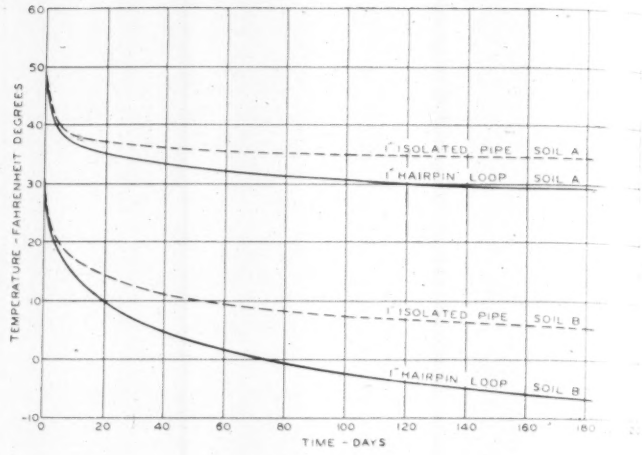
TEMPERATURE - FAHRENHEIT DEGREES
1" ISOLATED PIPE SOIL A
1" HAIRPIN LOOP SOIL A
1" ISOLATED PIPE SOIL B
1" HAIRPIN LOOP SOIL B
TIME - DAYS

Fig. 2. Comparison of isolated pipes and hairpin loops.[a]

[a] Pipes 30-in. apart in different kinds of soil. Heat absorbed, 20 Btu per (ft) (hr).

in *Example 1*, except that the rate of heat absorption is 80 Btu per (hour) (foot of pipe), (*i.e.*, at the same rate of absorption per *unit area* of pipe surface). See Fig. 1 for curve.

Solution. From Table 2 for $r = 2$ in. and $t = 731$ hr, soil type A, $T - T_o = -80 \times 0.49 = -39.2$ F, or $T = 10.8$ F. From Fig. 1 a temperature of 10.8 F may be read directly.

It is important to note that *the small pipe remains higher in temperature than the large one for the same rate of heat absorption per unit area, i.e. the small pipe is more efficient.* This is entirely reasonable since the (small) longer pipe has more earth from which to draw its heat. Ice formation with the accompanying release of latent heat may slow up the cooling process below the freezing temperature; it is also possible to handle this case analytically, but no attempt to do so will be made here. Such calculations as have been made indicate that the effect of the ice will not be so large as might be expected.

Example 3. Two 1 in. OD pipes are buried in the same trench 30 in. apart, each operating under the same conditions as the pipe in *Example 1.* What temperatures might be expected at the surface (*i.e.* inside) of either pipe after two months of operation?

Solution. Here each pipe draws heat, to some extent, away from the soil surrounding the other. The temperature of either pipe is that caused by a 20 Btu per (hour) (foot) sink 0.5 in. away and an equal sink approximately 30 in. away. This will give $T - T_o = -20 (0.72 + 0.18) = -18.0$ deg., so $T = 32.0$ F.

If only one pipe has been present, T would be 35.6 F.

The *hairpin loop* curves of Fig. 2 have been calculated in this way, using Table 2, and the value of 32.0 F may be read off at once. The single-pipe value of 35.6 F may be taken from either Fig. 1 or Fig. 2.

Example 4. A 1 in. OD pipe is buried 30 in. below a soil surface kept at 50 F, other conditions being the same as in *Example 1.* What is

Table 1—Values of the integral[a] $I(X)$ **for various values of** X

X	$I(X)$	X	$I(X)$	X	$I(X)$
0.0001	8.9217	0.16	1.5567	0.62	0.3646
.0002	8.2286	.17	1.4977	.64	.3433
.0003	7.8231	.18	1.4423	.66	.3231
.0004	7.5354	.19	1.3900	.68	.3041
.0005	7.3123	.20	1.3406	.70	.2860
.0006	7.1300	.21	1.2938	.72	.2690
.0007	6.9758	.22	1.2494	.74	.2529
.0008	6.8423	.23	1.2072	.76	.2377
.0009	6.7245	.24	1.1669	.78	.2234
.0010	6.6191	.25	1.1285	.80	.2098
0.001	6.6191	.26	1.0917	.82	.1970
.002	5.9260	.27	1.0565	.84	.1848
.003	5.5205	.28	1.0228	.86	.1735
.004	5.2329	.29	0.9904	.88	.1627
.005	5.0097	.30	.9594	.90	.1525
.006	4.8274	.31	.9295	.92	.1429
.007	4.6733	.32	.9007	.94	.1339
.008	4.5397	.33	.8731	.96	.1253
.009	4.4220	.34	.8464	.98	.1173
.010	4.3166	.35	.8206	1.00	.1097
0.01	4.3166	.36	.7958	1.02	.1026
.02	3.6236	.37	.7718	1.04	.0958
.03	3.2184	.38	.7487	1.06	.0895
.04	2.9311	.39	.7263	1.08	.0836
.05	2.7084	.40	.7046	1.10	.0780
.06	2.5266	.42	.6634	1.20	.0547
.07	2.3731	.44	.6247	1.30	.0379
.08	2.2403	.46	.5884	1.40	.0259
.09	2.1234	.48	.5543	1.50	.0174
.10	2.0190	.50	.5221	1.60	.0115
.11	1.9247	.52	.4919	1.70	.0075
.12	1.8388	.54	.4634	1.80	.0048
.13	1.7600	.56	.4365	1.90	.0030
.14	1.6873	.58	.4112	2.00	.0019
.15	1.6197	.60	.3872	2.20	.0007

For $X < 0.2$, $I(X) = 2.303 \log_{10} 1/X + X^2/2 - X^4/8 - 0.2886$

[a] See Equation 1.

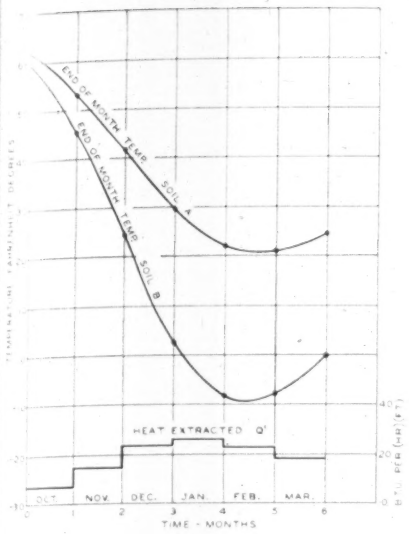

Fig. 3. Temperature at surface of a 1-in. horizontal pipe 6 ft below surface.[a]

[a] The pipe draws heat indicated by the step curve Q'. Annual variation is included.

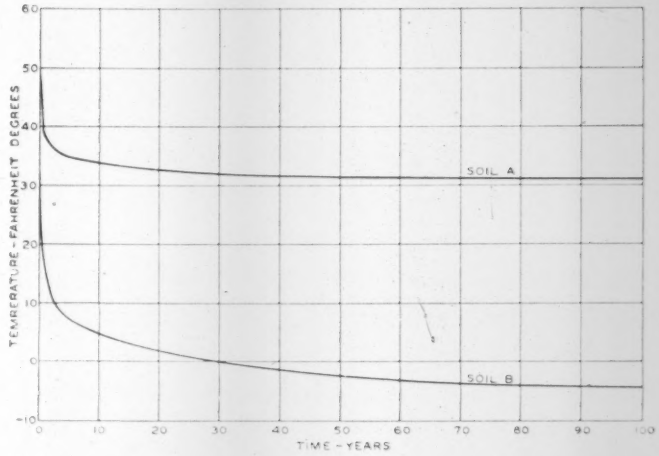

Fig. 4. Temperature at surface of 4-in. pipe in two different soils after long-time operation of heat pump.[a]

[a] Heat extraction 20 Btu per (ft) (hr).

the pipe temperature after six months of operation?

Solution. Here it is necessary[6] to assume a *negative image* of the pipe, *i.e.*, a source at the same distance above the surface as the sink is below. This gives $T - T_o = -20 \times (0.79 - 0.15) = -12.8$ deg, or $T = 37.2$ F.

Example 5. An isolated 1 in. OD ground pipe operates at an average absorption of 15 Btu per (hour) (foot) during the month of November and 30 for December. What temperature might be expected in the pipe on January 1? Other conditions are as in *Example 1.*

Solution. In this case the integral must be split into two parts, corresponding to each period of time, taking t in each case as the *time since the particular interval under consideration began or ended.* The solution would then be $T - T_o = -15 \times (0.72 - 0.67) + (-30) \times 0.67 = -20.8$ deg, or $T = 29.2$ F.

Example 6. A 1 in. OD pipe is buried in soil 6 ft. below a surface which has a sine variation in temperature, ranging from 25 F on February 1 to 75 F on August 1. The average absorption rates for the months October through March are 7.1, 15.1, 23.5, 25.9, 23.0, and 18.4[7] Btu per (hour) (foot of pipe), respectively. Calculate pipe temperatures on October 1, November 1, etc., for soils A and B (see Fig. 3).

Solution. In solving this problem proceed first as in *Examples 4* and *5* and calculate pipe temperatures accordingly. The effect of the periodic temperature variation of the ground is then calculated from the equation;[8]

$$T - T_o = T_1 \exp\left(-x\sqrt{\frac{\pi}{\alpha P}}\right) \cdot \sin\left(\frac{2\pi t}{P} - x\sqrt{\frac{\pi}{\alpha P}}\right) \quad (2)$$

where

T_1 = amplitude of temperature variation of ground surface, in this case 25 deg.

P = hours in one year, 8766.

x = distance from ground surface to center of pipe, feet.

Example 7. A 4 in. OD isolated pipe absorbs 20 Btu per (hour)

Table 2—Values of $T - T_o$[a] at various distances from a line source emitting at the rate of one Btu per hour per linear foot, after various times.

Distance[b]		$T - T_o$ (Fahrenheit degrees)									
		One week 168 hr		Two weeks 336 hr		One month 731 hr		Two months 1461 hr		Six months 4383 hr	
In.	Ft	Soil A[c]	Soil B[d]	Soil A	Soil B	Soil A	Soil B	Soil A	Soil B	Soil A	Soil B
0.25	0.0208	0.66	1.86	0.71	2.00	0.76	2.16	0.81	2.30	0.88	2.53
0.50	0.0417	0.57	1.61	0.62	1.72	0.67	1.88	0.72	2.02	0.79	2.24
1.00	0.083	0.48	1.31	0.54	1.45	0.58	1.62	0.62	1.74	0.70	1.96
2.00	0.167	0.39	1.04	0.44	1.17	0.49	1.33	0.54	1.47	0.61	1.69
3.00	0.25	0.34	0.87	0.38	1.01	0.44	1.17	0.48	1.31	0.56	1.54
4.00	0.33	0.30	0.76	0.34	0.90	0.40	1.05	0.44	1.19	0.52	1.41
6.00	0.50	0.25	0.60	0.29	0.74	0.34	0.89	0.39	1.03	0.46	1.25
8.00	0.67	0.21	0.49	0.25	0.63	0.30	0.78	0.35	0.92	0.42	1.13
12.0	1.00	0.16	0.34	0.20	0.47	0.25	0.62	0.30	0.75	0.37	0.97
18.0	1.50	0.11	0.21	0.15	0.32	0.20	0.46	0.24	0.60	0.31	0.81
30.0	2.50	0.05	0.07	0.09	0.16	0.13	0.28	0.18	0.40	0.25	0.61
60.0	5.00	—	—	0.02	0.02	0.06	0.08	0.09	0.17	0.15	0.35

[a] For a heat sink $T - T_o$ is negative

[b] Distance measured from center line of pipe

[c] Wet clay of high conductivity ($k = 1.2$, $c = 0.45$, $\rho = 102$, $\alpha = 0.0261$)

[d] Moist soil of medium low conductivity ($k = 0.4$, $c = 0.3$, $\rho = 100$, $\alpha = 0.0133$)

(foot) continuously for a century. Find pipe temperatures at the end of 1, 5, 10, 50, 100 years, if initial temperature is 50 F.

Solution. The solution of this problem as given in Fig. 4 is not without interest because in certain cases of deep (dry) wells the summer return of heat may be much less than the winter absorption. The value of 20 Btu per (hour) (foot) is, of course, very small for a 4 in. pipe, but this is the *average* for the year. It will be noted from the curves of Fig. 4 that the rate of temperature fall after about 10 years becomes very slow.

The theory outlined in this paper has been applied to several sets of data not yet released for publication with reasonably satisfactory results. The discrepancies have, in general, been explainable on the basis of lack of sufficient knowledge of all the factors concerned, particularly the thermal constants of the soil. The authors expect in the future to discuss other types of ground absorbers with plane or spherical shapes, but theory points to the long small deeply buried pipe as the most feasible solution of the ground source problem under average conditions.

On the basis of theory the following general statements may be made:

1. The temperature drop in a pipe is, in general, proportional to the rate of heat absorption. This would not be true in *Example 6* because of the effect of the ground surface variation. However the part due to the pipe alone would follow this rule.

2. For a given surface a long small pipe is much more effective than a shorter large one.

3. The soil diffusivity enters as a factor as well as the conductivity, although the latter, on the whole, is the more important.

4. A loop with two pipes well separated in the same trench, while not as efficient per foot of pipe as two isolated pipes, is permissible unless very long periods of operation are concerned. For short-period high-capacity operation (*i.e.*, in a cold spell) it would be almost as efficient as two isolated pipes.

5. It is doubtful if projections on the surface of a pipe give as much return for the money spent as the same amount expended on more pipe.

6. For a given length of pipe a coil is much less efficient than the same length stretched out more or less straight.

7. Deep vertical wells, even if dry, have certain obvious advantages, but if operated for years with more heat extracted in winter than is returned in summer it is advisable to calculate the possible effect of a progressive local cooling of the ground near the pipe. A study of Fig. 4, however, would indicate that this is not likely to be a serious matter.

In conclusion it may be remarked that the problem of the heat dissipation from the buried electric power cable has some items in common with the problems treated in this paper.

References

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2. Theory of Heat Losses from Pipes Buried in the Ground, by John R. Allen. (ASHVE TRANSACTIONS, Vol. 26, 1920, p. 335.)

Heat Transfer from Ground to Water in Buried Coils, by W. P. Kinz and M. S. Martus. (*Heating and Ventilating,* July 1947, p. 71.)

Heat Transmission, by W. H. McAdams. (McGraw-Hill Book Co. Inc., New York, 1942, p. 15.)

3. Technical Memorandum No. 630, by V. M. Kingston. (U.S. Bureau of Reclamation, Denver, 1946.)

4. *Mathematical and Physical Papers,* by Lord Kelvin (Sir W. Thomson), II, p. 41 ff.

5. *Heat Conduction with Engineering and Geological Applications,* by L. R. Ingersoll, O. J. Zobel and A. C. Ingersoll. (McGraw-Hill Book Co., Inc., New York, 1948. p. 152.)

6. Reference 5, p. 154.

7. From data furnished to authors by M. S. Oldacre.

8. Reference 5, p. 47.

FRENCH AWARD MEDALS TO RABER AND HUTCHINSON

Prof. B. F. Raber and Prof. F. W. Hutchinson, University of California, Berkeley, Calif., have been accorded the distinguished honor of being awarded bronze medals by the Union des Chambres Syndicales du Chauffage de France for their joint paper, Rational Analysis of Panel Heating and Cooling Systems, presented in their behalf at the 7th Heating and Ventilating Congress held in Paris in September 1947. The paper correlated and summarized the results derived from the data of a research program on panel heating and cooling conducted at the University of California as a cooperative project of the ASHVE. The accompanying photographs show the front and reverse sides of Professor Raber's medal. A similar medal was awarded to Professor Hutchinson.

B. F. Raber
Berkeley, Calif.

Photo by A. E. Bent, 1941

Front and back of Professor Raber's medal

F. W. Hutchinson
Berkeley, Calif.

CHARTER TO N. C. STATE COLLEGE STUDENT BRANCH

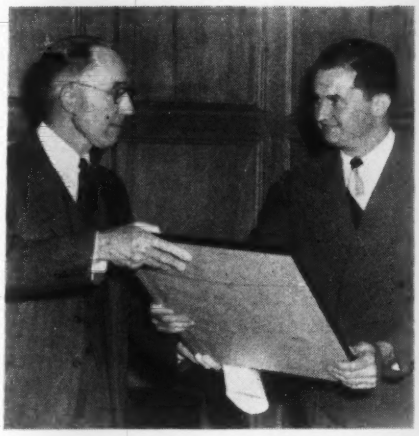
The North Carolina State College Student Branch of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS was organized at a banquet meeting May 7 at the Carolina Hotel, Raleigh, N. C.

M. F. Blankin, Philadelphia, Pa., past president of the Society and a member of its Advisory Board, outlined the aims and activities of the organization.

He reported that the Society, which has been functioning since 1894, now has over 6,000 members, and he emphasized the significance of the Society's research work, which is done largely at the organization's own Laboratory in Cleveland.

Heating and ventilating engineers, he explained, are concerned primarily with problems concerning fuel conservation, smoke abatement, air pollution, and other factors affecting the public's health and general welfare.

The charter of the Student Branch was presented by H. E. Sproull, Cincinnati, Ohio, a member of Council.



H. E. Sproull, member of Council from Cincinnati, Ohio, presented the Charter to H. Walker Powell, Jr., Orlando, Fla., the Student Branch President

Other talks were made by Prof. R. B. Rice, head of the State College Department of Diesel and Internal Combustion Engines; E. S. deWitt, Charlotte, president of the North Carolina Chapter of the Society, and A. V. Hutchinson, New York, the Society's secretary.

The State College Student Branch is one of three organizations of its kind in the nation. Similar organizations have been established at Texas A. & M. College, College Station, Tex., and at Purdue University, W. Lafayette, Ind.

H. W. Powell, Jr., Orlando, Fla., was installed as the State College Student Branch's first president during the meeting. Other officers are James C. Lodor, Wilmington, N. C., vice president; Clinton E. Jones, Tarboro, N. C., secretary; John G. Marshall, Glen Rock, N. J., treasurer; and E. B. Morrison, Charlotte, N. C., reporter.

J. B. Alexander, Charlotte, a student at the College, was toastmaster at the meeting.

W. W. LIGE, MANAGER OF NATIONAL ACCOUNTS

R. E. Bell, vice president, Bell and Gossett Co., Morton Grove, Ill., has announced the appointment of W. W. Lige as manager of national accounts for the company. Becoming associated with Bell and Gossett in 1940, Mr. Lige was in charge of the Cleveland office for a number of years. He joined the ASHVE in 1940.

(left to right) **R. M. Warren, E. S. deWitt, J. C. Lodor, A. V. Hutchinson, W. M. Wallace, II, M. F. Blankin, J. G. Marshall, H. Walker Powell, Jr., Prof. L. L. Vaughn, J. B. Alexander, Prof. R. B. Rice, H. E. Sproull and E. B. Morrison**

JOURNAL SECTION

Summary of Local Chapter Meetings *

ATLANTA—May 7, 1948. A feature introduced for the first time at this meeting was the new system of attendance and indentification cards. Its operation was explained by G. B. Hightower, chairman of the attendance committee. The treasurer made a very favorable report, and W. M. Garrard, chairman of the social and house committee laid before the members preliminary plans for the proposed June social meeting. A banquet, with entertainment, was announced for June 11. Pres. L. L. Barnes announced the death of Edward W. Klein, who had only recently been made a Life Member of both the Society and the Atlanta Chapter. President Barnes introduced the speaker of the evening, Maurice Wilson, Carrier Corp. His excellent talk on multi-room air conditioning systems was followed by a lively discussion. Attendance 69. Attendance ratio 0.59.

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CONNECTICUT—April 21, 1948. Announcements of special interest to all the members were made by Curtiss L'Hommedieu, chairman of the meetings committee, concerning a meeting to be held on May 25, at New Haven, with T. A. Walters, Detroit, Mich., as the speaker, and the annual outing and golf meeting scheduled for June 25 at the Avon Country Club. W. K. Simpson, a member of the legislative committee, commented on the failure of engineers to secure passage of a bill to reduce the renewal fee for state registration. The delegates committee made the following suggestions: (1) that a committee of public relations be appointed to help secure speakers for chapter meetings and to assist in improving attendance; (2) that letters be sent to chapter members concerning the choice of subjects for discussion at meetings; and (3) that the time of election of chapter officers be changed to coincide with that of the Society's elections. Dr. C.-E. A. Winslow, past president of the Society, presented each of the chapter past presidents, and was presented with a Life Membership certificate in the Society. Pres. S. R. Osborne, retiring, turned the meeting over to the new president, E. C. Marsden, who, with the following other officers, was elected at this meeting: *Vice President*—Winfield Roeder; *Secretary*—T. L. Arnold; *Treasurer*—D. M. Hummel; and *Board of Governors*—J. R. Smak, Albert J. Lawless, and S. R. Osborne. Attendance 61. Attendance ratio 0.29.

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CENTRAL OHIO—May 10, 1948. An interesting and enjoyable inspection trip through the New Chrysler Airtemp Plant, Dayton, Ohio, was arranged by the chapter program committee. After dinner at the Dayton Engineers' Club, the group assembled at the Chrysler Building, which is completely air conditioned and is of windowless construction. Following a brief discussion of the heating and cooling systems the members and guests were escorted through the offices, the manufacturing plant, and the laboratory. The Chapter officers for the 1948-49 season were announced as follows: *President*—W. M. Myler, Jr.; *Vice President*—E. A. Norman, Jr.; *Secretary*—H. G. Hays; *Treasurer*—R. S Curl; *Board of Governors*—M. R. Hamlin and A. W. Williams. Attendance 87. Attendance ratio 0.46

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DELTA—May 11, 1948. The Chapter was fortunate in having as guest speaker of the evening a very interesting person with an unusual and fascinating topic. Warren Moses gave a vivid and informative account of the experiences of an airborne engineer.

The following new officers were elected: *President*—L. V. Busenlener; *Vice President* — R. B. Guest; *Secretary*—Ralph Elizardi; *Treasurer*—J. S. Adair; *Board of Governors*—Fritz Gutknecht, Ted Offner, and J. S. Burke, *ex officio*. Past president Burke was presented with a pen and pencil set by the chapter, in appreciation of his loyal and efficient service. C. B. Gamble presented to the meeting the Fire Code requirements pertaining to air conditioning as outlined by the State Fire Marshal. A discussion brought out the fact that, while this code is not yet law, it is not unlikely that some action toward that end will be taken at the next meeting of the State Legislature. Attendance 32.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Members of Central Ohio Chapter of ASHVE at Chrysler Airtemp plant, Dayton, Ohio, prior to inspection tour at May meeting

DELTA—April 9, 1948. The Research Activities of the Society was the topic discussed by Cyril Tasker, director of research of ASHVE, Cleveland, Ohio. After Mr. Tasker's very interesting talk, the problem of air conditioning southern schools was mentioned by G. E. May, and Mr. Tasker stated that he would report this back to the Society's Council. He also stated that he felt that they would request a hundred percent cooperation. Pres. J. S. Burke made a request for a motion that each April meeting be dedicated to all past presidents; he then presented all Chapter past presidents with a certificate of merit. Attendance 33.

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GOLDEN GATE—May 6, 1948. Important business was transacted at this meeting, including election of the following new officers: *President*—H. V. Hickman; *Vice President*—K. F. Baldwin, Jr.; *Secretary*—R. C. Cushing; *Treasurer*—P. R. Babcock; *Board of Governors*—John Everetts, Jr., H. R. Scandrett, and T. J. Janes. A report of the membership committee showed a net gain of 24 for the year. Among several amendments passed and adopted was the following: *The annual meeting of this chapter shall be held in San Francisco and shall be the regular January meeting.* A feature of the evening that was both pleasant and informative was the talk by E. W. Simons, a chapter member, on Operating Conditions of Cooling Towers and Evaporative Condensers. He showed the gift of being able to make a technical subject readily comprehensible and extremely interesting. Attendance 63.

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ILLINOIS—May 10, 1948. The Chapter had the honor of having as guest speaker, Prof. G. L. Tuve, president of ASHVE and head of the mechanical engineering department at Case Institute of Technology, Cleveland, Ohio. Before delivering his formal address, Professor Tuve discussed the coming Annual Meeting of the Society at Chicago in January 1949, and stated that, according to all indications, it should be the largest meeting of ASHVE in its history. He then gave a most interesting talk on the subject, Professional Air Control—1960. The speaker emphasized the aim of the modern engineer to eliminate maintenance and service worries; the need for a greater understanding of the field of control; the Society's direction of research and the desire for broader chapter interest; results of research in air distribution through various designs and types of grilles; and the place of the modern engineer in relation to his historical background.

The following new officers were elected: *President*—C. M. Burnam, Jr.; *Vice President*—J. S. Kearney; *Treasurer*—P. J. Marschall; *Secretary*—G. W. Bornquist; *Board of Governors*—M. J. Bamond, M. W. Bishop, and H. G. Chapin.

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INDIANA—April 23, 1948. A feature of the meeting was the presentation, by Council Member C. F. Boester, of the Purdue Student Branch charter to Prof. W. T. Miller, who expressed his appreciation. Pres. I. W. Cotton announced that all active officers and the board of governors will attend the first Student Branch meeting at Purdue, and also that members of the chapter included in the district of the Indiana Chapter would be invited to the first meeting of the board of governors next fall. Excellent talks were given by D. F. Alexander and C. F. Henney, of General Motors Corp., on mobile air conditioning, especially on buses and railroad cars, and with particular reference to the General Motors Train of Tomorrow. B. J. Van Doren, of the Frigidaire Division of General Motors, closed the meeting with his informative talk, Experience Gained in Showing the Train of Tomorrow Across the Country. Attendance 77.

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IOWA—May 11, 1948. The highlight of the meeting was a discussion of the Mollier psychrometric chart by J. F. Sandfort, assistant professor of mechanical engineering at Iowa State College, Ames, Ia. He touched upon the original chart as introduced by Dr. W. H. Carrier, compared it with various log charts such as Bulkeley's, explained how certain manufacturers' charts were developed, and finally made clear why and how the Mollier chart is capable of accomplishments beyond the possibilities of other charts. The business of the meeting included a financial report for the year; a vote that the secretary be instructed to send greetings to the newly chartered chapter in Louisiana; and election of the following officers: *President*—D. C. Murphy; *Vice President*—D. E. Wells; *Secretary-Treasurer*—R. S. Stover; and *Board of Governors*—J. F. Sandfort, C. P. North, and C. A. Wheeler. Attendance 25.

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KANSAS CITY—May 4, 1948. The featured speaker of the meeting was A. G. Dixon, Modine Manufacturing Co., Racine, Wis., who spoke on Convector Radiation — Comparison with Other Methods, Including Panel Heating. Mr. Dixon predicted increased use of steam and hot water heating and greater use of coal; compared the modern convector and cast-iron radiation; discussed the formation of the convector code committee and completion of the code in 1947; and stated his conviction that the future trend in the better installations would be toward the split system. Business included election of the following new officers: *President*—H. E. Gould; *Vice President*—Henry Nottberg, Jr.; *Secretary*—K. M. Stevens; *Treasurer*—W. E. Howarth; *Board of Governors*—Paul Leffel, E. K. Campbell, and C. A. Weiss. Announcement was made of H. E. Degler's talk to be given before the *ASRE* on May 13, and members were invited; and the Semi-Annual Meeting of ASHVE, June 20-23, at Bretton Woods, N. H., was also announced. D. M. Allen, a member of the Society's Council, presented to Henry Nottberg, Sr., a Life Membership Certificate, which, in his absence, was accepted by his son, Henry Nottberg, Jr. The chapter now has three life members. Henry Nottberg, Jr. presented a past president's certificate to the retiring president, P. C. Leffel. Attendance 58.

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KANSAS CITY—April 5, 1948. Mechanical Design Work was the title of

a talk given by S. R. Lewis, consulting engineer, Chicago, Ill., and past president of ASHVE. Introduced by N. W. Downes, Mr. Lewis talked of his many experiences in mechanical design work. He covered steam distribution systems, air raid shelters, hospitals, radiant heating, air conditioning and many other subjects, and mentioned the use of ethylene glycol in hot water heating systems to prevent freeze ups when plants are shut down. A very lively question and answer period followed Mr. Lewis' talk, indicating the great interest of the members. D. M. Allen, chairman of the chapter's nominating committee, presented the slate of officers for the 1948-49 season. Attendance 81.

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MANITOBA—May 20, 1948. As guest speaker, J. H. Fox, sales manager of the Minneapolis-Honeywell Regulator Co., Ltd., Toronto, Canada, contributed the outstanding feature of the evening in his address dealing with some of the great advances in the telephone, radio, automobile, and aircraft industries during the last quarter-century. He called special attention to the development of automatic features, for the consumer's convenience, in manufactured articles, and predicted an increasing trend along these lines. Mr. Fox stated that, according to the present outlook, Canada is justified in expecting a considerable period of prosperity.

The business of the meeting included election of the following new officers: *President* — J. R. Stephenson: *Vice President*—A. W. Moss; *Secretary-Treasurer* — D. F. Michie; *Board of Governors*—D. S. Swain, P. L. Charles, J. F. Bertram, E. H. Price, and J. A. Bell, with J. R. Stephenson, A. W. Moss and D. F. Michie, *ex officio*.

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MASSACHUSETTS — April 20, 1948. Subject: Radiant Baseboard Heating. Speaker: Prof. W. S. Harris, research associate professor, University of Illinois, Urbana, Ill. Professor Harris' instructive talk was accompanied by numerous slides and brought forth a lively discussion. Attendance 70. Attendance ratio 0.85.

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MEMPHIS — April 12, 1948. The chapter was honored in having as the speaker of the evening Cyril Tasker, ASHVE director of research, Cleveland, Ohio, who gave an enlightening and thought-provoking talk entitled, The Challenge of the Research Laboratory. The interest of the talk itself was enhanced by slides that did much to make this vital subject interesting. Business of the meeting included the election of the following officers: *President*—E. E. Scott; *Vice President*—W. E. Thorpe; *Secretary*—A. T. Bevil; *Treasurer*—J. D. Flinn. Attendance 31. Attendance ratio 0.68.

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MEMPHIS—March 15, 1948. Panel Heating and its Controls was the subject discussed by Ferdinand Jehle, chief engineer, Hoffman Specialty Co., Indianapolis, Ind. Mr. Jehle presented his subject in an interesting manner, using slides. In the opinion of the Chapter officers, Mr. Jehle's talk was judged one of the best of the year. The report of the nominating committee was given and it was announced that the election of officers will take place at the April meeting. Attendance 41. Attendance ratio 0.91.

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MICHIGAN—May 11, 1948. The meeting was featured by a presentation of Life Membership Certificates to chapter members E. M. Harrigan, Detroit, and Thomas Chester, Birmingham. The membership committee reported a net gain of 21 for the year. L. L. McConachie, past president, accepted the bronze President's Plaque and the President's Memory Book on behalf of A. E. Knibb, retiring president, who was absent on account of illness.

The following new officers were elected: *President*—E. F. Hyde; *Vice President*—L. A. Burch; *Treasurer*—C. F. Donohoe; *Secretary*—J. H. Spurgeon; *Board of Governors*—G. W. Akers, R. H. Oberschulte, and J. H. Spitzley. A golf meet was a part of the occasion, and a rising vote of thanks was given all those concerned with its planning. After the business meeting, various prizes were awarded. Attendance 6

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NEBRASKA—May 11, 1948. A feature of the meeting was a very interesting and informative talk by Larry Shoemaker, sales promotion manager, Northern Natural Gas Co. He gave considerable time to an explanation of what the pipe-line companies are doing throughout the country toward alleviating the gas shortage. Since most of the audience had some kind of connection with the gas industry, his talk was enthusiastically received. It was decided that the June meeting would be held at the Country Club, Lake Manawa, Ia., and that election of officers will be conducted on that occasion. A spirited discussion took place on the question whether the chapter delegate should serve for one year only or for two or three years. It was decided to select a new representative each year. Attendance 54.

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NEW YORK—May 17, 1948. Chain Store Air Conditioning was the topic of a talk by B. A. Jacobi, chief engineer, Lerner Shops, New York, N. Y. Mr. Jacobi discussed the essential features of design, installation, operation and maintenance of air conditioning systems for retail stores and shops. He showed how the merchandising methods and the architectural and decorative requirements of stores affect the design and operation of the systems. He stated that air conditioning was used in all of the 200 stores operated by the Lerner Shops, and had been found to effect not only an increase in business, but also a considerable saving in spoilage of goods. The talk was followed by a question and answer period which gave the audience an opportunity to obtain a great deal of additional information based on Mr. Jacobi's experience. Pres. M. C. Giannini announced that the Board of Governors of the New York Chapter had voted an additional gift of $320.00 (representing the equivalent of $1.00

per member) from the chapter treasury toward liquidation of the mortgage on the Research Laboratory. President Giannini expressed his appreciation to W. E. Heibel for his efforts as general chairman of the Committee on Arrangements for the 54th Annual Meeting in New York, and to Clifford Strock, chairman of the chapter's program committee, who had provided such interesting speakers during the year. Attendance 125. Attendance ratio 0.25.

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NEW YORK—April 19, 1948. Radiant Baseboard Panel Heating was the subject of discussion by Prof. W. S. Harris, University of Illinois. Professor Harris discussed results of the tests of radiant baseboard panels as conducted in two research residences at the University of Illinois. Comparisons were made with the column radiation showing air temperatures at various locations and indicating the value of radiant baseboard heating in maintaining low temperature differentials between floor and ceiling. A lively discussion was held after which Professor Harris was given a rising vote of thanks. C. H. Flink, secretary, presented his annual report indicating that the present chapter membership of 318 was an all-time high for the chapter. O. F. Quist, Jr., chairman of the board of tellers, presented the report of his committee and announced the election of the following officers: *President*—A. A. Bearman; *Vice President*—H. S. Johnson; *Secretary*, C. H. Flink; *Treasurer*—W. M. Heebner; *Board of Governors*—M. C. Giannini, P. B. Gordon, E. G. Graber, C. F. Kayan, J. E. Schechter. Attendance 130. Attendance ratio 0.23.

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OKLAHOMA—May 10, 1948. The Chapter was fortunate in having as guest speaker H. C. Pierce, assistant manager, Air Conditioning Division, Servel, Inc., Evansville, Ind. He is also chairman of the Engineering Committee of the *Air Conditioning and Refrigerating Machinery Association*. Mr. Pierce gave an interesting and informative talk on the principle of absorption cooling. In the discussion that followed, S. T. Husky, manager of the Air Conditioning Department of Servel's local distributor, played an important and helpful part. The business of the meeting included details of the forthcoming Semi-Annual Meeting of the Society at Bretton Woods, N H., June 20-23, 1948.

The following new officers were elected: *President*—J. H. Spaan; *Vice President*—J. H. Carnahan; *Secretary-Treasurer* — J. R. Patten; *Board of Governors* — W. W. Frankfurt, G. T. Donceel, and E. F. Dawson.

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ONTARIO—May 3, 1948. An outstanding feature of the occasion was a talk by Gordon Volkenant, associate director of research, Minneapolis-Honeywell Regulator Co., on the subject, Gadgets, Gimmicks, and Electronics. Mr. Volkenant's address was one of the best and one of the most popular ever delivered before the chapter. Business of the meeting included committee reports, including membership and attendance. There were 22 applications for membership during the past year, and an average attendance of 93 members.

The following new officers were elected by acclamation: *President*—E. G. Spall; *Vice President*—A. J. Strain; *Secretary-Treasurer*—H R. Roth; *Board of Governors*—J. H. Fox, William Philip, H. A. Baxter, and D. A. Stott, *ex officio*. It was announced that the chapter's University of Toronto award was given this year to J. H. Howard, who won over four other contestants submitting theses. Other features were the presentation of a past president's certificate to retiring president Stott, and the awarding of a Life Membership Certificate in

JOURNAL SECTION

ASHVE to A. S. Leitch. Attendance 81. Attendance ratio 0.48.

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ONTARIO—April 5, 1948. Joint meeting with Western New York Chapter at General Brock Hotel, Niagara Falls, Ont. Subject: The World Today. Speaker: Rob Roy McLeod, vice president and director of the Niagara Hudson River Co. Mr. McLeod gave a most timely and interesting summation of the current world situations, drawing attention to similar situations in the past. An afternoon technical session was held with Joe Davis of Buffalo, presiding and the evening session was in charge of Edwin Woolcock. Attendance 114. Attendance ratio 0.49.

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OREGON—April 12, 1948. Special Meeting. Subject: Major Problems Currently Before the Society Officers. Speaker: G. L. Tuve, president of ASHVE and head of mechanical engineering, Case Institute of Technology, Cleveland, Ohio. President Tuve stressed the importance of the chapters working closely with the Society on research problems, and in this connection he urged members to submit papers concerning unusual installations for use in the JOURNAL. A close relationship with the medical profession, electronic engineers, and architects was urged by President Tuve, and he commented on the need for more attention to the field of supersonics.

Pres. and Mrs. G. L. Tuve with W. R. Norte at left, former student of President Tuve's, and E. R. Lokey at right, president of Oregon Chapter

President Tuve prophesied that the Society would have to increase dues to meet present costs or reduce the material now given free with membership affiliation. Many questions followed this interesting talk. The diverse activities of the Oregon Chapter, including its participation in the revision and formulation of building and heating codes, were fully explored. Attendance 21.

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PACIFIC NORTHWEST — April 13, 1948. The chapter had as its distinguished guest and speaker Prof. G. L. Tuve, president of the ASHVE, and head of mechanical engineering at Case Institute of Technology, Cleveland, Ohio, who gave a talk on the subject, Professional Air Control—1960. His remarks were both enlightening and provocative and, at the conclusion of his address, the meeting was thrown open for discussion, in which the participation was both general and enthusiastic. This was the annual meeting at which the results of sealed ballots for the election of new officers were read: *President*—L. L. Bysom; *Vice President*—J. D. Sparks; *Treasurer*—R. R. Kirkwood; *Secretary*—D O. Mead; *Board of Governors*—C. A. Pangborn and J. B. Notkin.

Acting upon a memorandum from A. V. Hutchinson, secretary of the Society, the members decided that past president emblems may be purchased by individuals desiring them. The chapter was informed of a letter from the *ASME* inviting all engineers and guests to attend a meeting of the Heat Transfer and Fluid Mechanics Institute at Los Angeles, June 21 to 23, 1948, inclusive. Treas. J. D. Sparks announced receipt of $25.00 in response to the Puget Sound Engineering Council's appeal for contributions toward securing the Engineers' Registration Act, recently passed. Attendance 49.

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PACIFIC NORTHWEST — March 5, 1948. This was a joint meeting with the Pacific Northwest section of the *ASRE*, on its regular meeting date. The conduct of the meeting was shared by Chairman Dick Stern *ASRE*, Joe Wilderman, program committee chairman, and E. H. Langdon, president of the ASHVE Pacific Northwest Chapter. The evening was noteworthy for the presentation of two informative, well-delivered talks, one on Heat Pumps in An Office Building, by J. Donald Kroeker, consulting engineer of Portland, Ore., and first president of the Oregon Chapter; the other on Proper Air Distribution in Air Conditioning Installations, by J. B. Hewett, sales manager, Anemostat Corp. of America, New York, N. Y. Mr. Kroeker used as examples two Portland buildings: the Oregonian and the Equitable. The latter is the first non-utility building to use heat pumps, and one of the first fully air conditioned office buildings. Mr. Kroeker explained various factors and formulas used in the installations and showed slides illustrating the layout. Mr. Hewett gave the audience the benefit of his experience in his explanation of the factors and procedure inherent in the problem of proper air distribution in air conditioning installations. He illustrated his talk with both slides and motion pictures. Both the talks were followed by general discussions. Attendance 60.

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PITTSBURGH—May 10, 1948. After a report for the first quarter by the treasurer, B. B. Reilly, and a report by J. L. McCann, chairman of the entertainment committee, on the golf meet to be held at the Chartiers Country Club, the following new officers were unanimously elected: *President*—H. E. Park; *Vice President*—H. J. Kirkendall; *Treasurer*—B. B. Reilly; *Secretary*—Edward H. Riesmeyer, Jr.; *Board of Governors*—D. W. Loucks, C. H Schneider, and W. D. Simpson. The retiring president made his report and recommendation, and introduced the new president, who made a brief speech. The business meeting was then adjourned and there was entertainment, which included music, songs, and card tricks by a guest artist. Attendance 54.

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ST. LOUIS—May 4, 1948. Collecting Dust from the Air with the Use of Electrostatic Precipitation s selected as the topic for d ssion by J. W. May, director r research, American Air Fil Co. Louisville, Ky. Mr. May phasized his very interesting d enlightening discussion with slides The talk was followed by very enthusiastic question and nswer period. B. L. Evans, chair an, of the meetings committee presented the annual report of the past year's meetings. J. S. Rosebrough, secretary, read the names of the officers submitted by the nominating committee. A motion was made by M. F. Carlock, seconded by E. E Carlson, that officers presented by the nominating committee be accepted, and the motion was unanimously passed. G. W. F. Myers then conducted the installation of officers as follows: *President*—B. L. Evans; *First Vice President*—W. A. Russell; *Second Vice President* — J. S Rosebrough; *Secretary* — C. H Burnap; *Treasurer*—H. C. Sharp; *Board of Governors*—G. W. Pieksen, G. H. Bemarkt, J. H. Carter, L. L Hamig. Attendance 58.

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SOUTH TEXAS—May 21, 1948. A feature of the evening was an informative talk by Hollis De Vines in which he presented some impressive sidelights on the subject of atomic energy. The business of the meeting included interesting reports on the work and progress of various committees including the attendance, program, code, membership, publications, research, and placement committees. The treasurer, R J. Salinger, made a very favorable report on the Chapter's finances. A. F. Barnes, Chapter member of the Engineers' Council of Houston, reviewed the growth and progress of the Council and B. P. Fisher and W. E. Long gave the highlights of the 4th Annual Air Conditioning Conference. The following new officers were elected: *President*—C. C Quin; *Vice President*—L.L.Ladewig; *Secretary*—R. J. Salinger; *Treasurer*—H.W.Broadwell; *Board of Governors*—G. J. Collins and W. E. Long. It was decided to hold summer meetings, and C. J. Fleming was appointed as chairman of the June picnic committee. D. M. Mills was

selected to serve as delegate to the summer meeting.

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SOUTHERN CALIFORNIA — May 19, 1948. A panel discussion of Evaporative Cooling *vs.* Mechanical Refrigeration in Comfort Air Conditioning was the feature of the evening. E. J. Berlet and W. L. Holladay spoke for refrigeration and R. S. Farr and Leo Hungerford for evaporative cooling. A. J. Hess acted as moderator. The formal discussion was followed by an animated general discussion. In the business meeting, Mr. Hess emphasized that now was the time to voice any objections or suggest any revisions relative to the new sanitation ordinance currently being drafted. Members were urged to attend the Heat Transfer and Fluid Mechanic Institute meeting, June 21, 22, and 23. Mr. Hungerford presented a Life Membership Certificate to E. C. Evans.

The following new officers were elected: *President*—R. S. Farr; *Vice President*—John L. Blake; *Secretary*—Lloyd Helms; *Treasurer*—Maurice Greiner; *Board of Governors*—Nicholas Nassir, *chairman*, F. B. Gardner, and Ralph Phillips.

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SOUTHERN CALIFORNIA — April 21, 1948. Growing Pains in the Society was the subject of the talk by Dr. Baldwin M. Woods, past president of ASHVE, and director, University Extension, University of California, Berkeley, Calif. Dr. Woods presented an outline of the functions of the Society Officers, Council and committees, and pointed out the limitations which were imposed on each group by the democratic nature of the organization. He then mentioned his own obligations when president of the Society, saying that due to the increased number of chapters, it was impossible for him to visit all of them during his term in office. The problem of adapting the Society finances to the growth of the Society, the expanding research program, and the constantly changing economic conditions were also outlined by Dr. Woods. When his speech was concluded, Dr. Woods was asked many questions, most of which concerned the Research Laboratory and projects. A. J. Hess was appointed chapter delegate to attend the Semi-Annual Meeting in Bretton Woods in June, and R. S. Farr was appointed to represent the Chapter in the *Construction Industries Association*. M. C. Greiner was delegated to represent the chapter and assist Dean L. M. K. Boelter with the Heat Transfer and Fluid Mechanics Institute scheduled for June. Attendance 62.

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WASHINGTON, D. C. — April 14, 1948. Atomic Energy—Past and Future. Speaker: Dr. L. B. Heilprin explained the basic theory of nuclear physics, methods presently used to control the *chain reaction*, and the possibilities of utilization as a source of useful power during peacetime. After a question and answer period, two interesting sound films were shown. Pres. H. H. Hill called upon R. S. Dill to introduce Dr. R. J. Sargent, a visitor from the University of Sheffield, England. Dr. Sargent, experiencing his first visit to the United States, expressed appreciation for his reception in this country, and extended unofficial felicitations from the engineers of England. G. R. Walz, chairman of the membership committee, reported that during the first 11 months of the chapter year, 12 new Chapter members had been enrolled and 12 applications for membership in the Society had been forwarded to the Society heaquarters office. The following officers were elected for the 1948-49 season: *President*—A. S. Gates, Jr.; *Vice President*—P. R. Achenbach; *Treasurer*—F. J. Pratt; *Secretary*—J. G. Muirheid; *Board of Governors*—H H. Hill, A. E. Beitzell, L. H. Holder. Attendance 43.

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WESTERN MICHIGAN—April 19, 1948. Silicones—New Heat Stable Materials, was discussed by W. A. Wiard, Dow-Corning Corp., Midland, Mich., assisted by John Church. An interesting talk was given, illustrated by slides, showing the wide possible uses that this little known material appears to have. A progress report showing an increase of membership from 73 to 79 was read, and the treasurer reported the balance to date. An invitation to attend a joint meeting with the Indiana Chapter was read. Nominations for officers in the National Society were requested and the names of those nominated are to be turned over to the Board of Governors for action. Attendance 77. Attendance ratio 0.97 .

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WESTERN NEW YORK—May 10, 1948. The meeting featured an interesting talk ably presented by H. T. Kucera, president of the Automatic Devices Co., Chicago, Ill., on the timely subject of outside controls and the use of this type of temperature regulation in connection with multiple - dwelling buildings. The business of the meeting included a financial report showing a surplus of $61.00 to be divided between the Toronto and Western New York Chapters, after their joint meeting; congratulations to the local chapters on raising approximately $700.00 for the Society's Mortgage Retirement Fund; a report on preliminary plans for golf at the Wanakah Club; and announcement of election of officers as follows: *President*—Edwin Woolcott; *First Vice President*—F. J. Weber; *Second Vice President*—J. H. Bryce; *Secretary*—T. F. Killeen; and *Treasurer*—B. C. Candee. Attendance 29. Attendance ratio 0.38.

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WESTERN NEW YORK—April 5, 1948. Joint meeting with Ontario. Business was dispensed with. A panel discussion, conducted by Joseph Davis, was held on the subject, Trends in Heating. Later, the featured speaker was Rob Roy McLeod, vice president and director of the Niagara Hudson River Co., who gave an inspiring address on the rise and fall of both ancient and modern powers. Another highlight of the occasion was the hospitality hour-dinner and entertainment arranged by Frank Weber and his Committee, with J. Godfrey serving in the capacity of toastmaster.

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WISCONSIN—April 19, 1948. The Psychrometric Chart was the title

of a talk by Prof. William Goodman, Illinois Institute of Technology, Chicago, Ill. Professor Goodman indicated that the psychrometric chart is now used mainly to determine wet bulb temperature, dry bulb temperature, relative humidity, and moisture content of air vapor mixtures. He felt, however, that the chart is far more useful as a means of providing a graphical analysis of inumerable air conditioning processes. He illustrated several of these processes with slides, and indicated the manner in which many of these problems could be analyzed. He also covered the problem of determining the wet bulb temperature of air vapor mixtures below 30 deg. The talk was enthusiastically received and the speaker was given a rising vote of thanks. B. M. Kluge, secretary, reporting for the nominating committee, presented the slate of officers for the 1948-49 season. Attendance 65.

Student Branch

TEXAS A. & M.—April 15, 1948. S. E. Ammons reported on plans for the joint meeting of the Texas Chapters of the ASHVE to be held at the Texas A. & M. College on May 11, and which will take place at the Fin Feather Club, Bryan, Tex. A short talk was given by Prof. V. E. Long, outlining the air conditioning conference which will take place on the campus, April 26-28, in the YMCA auditorium. R. F. Phillips gave a short report on plans for an exhibit on Engineers Day. Attendance 35.

TEXAS A. & M.— April 1, 1948. Subject: There is an Engineering Reason. Speaker: L. C. Cambell. After a brief talk, Mr. Cambell showed an interesting film entitled, Embodied Steam Power Equipment. W. E. Long said a few words concerning summer and steady employment, and reminded the students of the approaching air conditioning conference. Attendance 30.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 127 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by July 25, 1948, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ADAMS, J. S., Distribution Engr., Peoples Natural Gas Co. PROPOSERS: N. M. Blanchard, K. R. Magarrell. SECONDERS: Verne Simmonds, O. J. Smith.

ALLMOND, G. W., Tech. Dir., Messrs. Fred G. Alden, Ltd. PROPOSERS: R. E. Otter, C. P. How. SECONDERS: Bernard Smith, L. A. Bawden.

ANDERSEN, T. H., Student, Purdue University. PROPOSERS: Y. S. Touloukian, F. B. Morse. SECONDERS: W. T. Miller, P. C. Zmola*.

ANDERSON, A. V. JR., Student, Purdue University. PROPOSERS: W. T. Miller. F. B. Morse. SECONDERS: W. A Knapp*, D. S. Clark*.

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BAILEY, P. D., Student, Purdue University. PROPOSERS: W. T. Miller, A. C. Menke. SECONDERS: K. R. Baugh*, C. J. Hambley.

BARNARD, H. A., Gen. Mgr., Sidles Conditioned Air Co. PROPOSERS: F. E. Prawl, Verne Simmonds. SECONDERS: K. R. Magarrell, G. W. Colburn.

BARNES, C. M., Dir. of Air Cond. School, Industrial Training Institute. PROPOSERS: M. J. Bamond, H. C. Stevens. SECONDERS: G. W. Bornquist, F. W. Thompson.

BARNES, TAYLOR, Pres., Bar-Brook Mfg. Co., Inc. PROPOSERS: B. Segall, Jr., W. E. FitzGerald. SECONDERS: E. J. Kearby, R. W. Hopper.

BELL, S. F., Mgr., Crane Co. PROPOSERS: R. L. Simpson, C. W. Freeman. SECONDERS: J. R. Smak, E. C. Marsden.

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BLACK, J. G., JR., Engr., Spitzley Rettenmier Sheet Metal Co. PROPOSERS: J. H. Spitzley, G. L. Davis, Jr. SECONDERS: L. A. Burch, F. X. Marzloff.

BONDI, FRED, JR., Jr. Engr., John Paul Jones, Cary & Millar. PROPOSERS: T. D. Dravage, R. L. Byers. SECONDERS: R. A. Urban, E. E. Maurer.

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BOWER, G. L., Mgr. Industrial Dept., Crane Co. PROPOSERS: W. S. Hague, W. C. Bevington. SECONDERS: I. W. Cotton, S. E. Fenstermaker, Jr.

BREHM, H. P., Engr., Meginnis & Schaumberg. PROPOSERS: K. E. Martin, G. E. Merwin. SECONDERS: P. J. Pospisil, Verne Simmonds.

BROWN, C. M., Student, A. & M. College of Texas. PROPOSERS: W. E. Long, G. R. Tippett. SECONDERS: C. M. Simmang*, E. S. Holdredge*.

BUCKLEY, J. B., Way Engrg. Co. PROPOSERS: W. J. Way, E. G. Floeter, Jr. SECONDERS: R. H. Wittbold, Norman Way.

CARTER, L. H., JR., Jr. Engr., The Dykes Co., Inc. PROPOSERS: L. D. Parsons, Jr., R. W. Hopper. SECONDERS: J. H. Reed, J. L. Bradley.

CLARKE, G. S., Sales Engr., The Trane Co. PROPOSERS: T. F. Rockwell, R. M. Toucey. SECONDERS: E. H. Riesmeyer, Jr., Roy Brauer.

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*Non-member.

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MALSTROM, L. P., Student, University of Illinois. PROPOSERS: R. J. Martin*, J. R. Carroll, Jr. SECONDERS: H. D. Bareither, S. Konzo.

MCALISTER, B. A., Student, A. & M. College of Texas. PROPOSERS: W. E. Long, G. R. Tippett. SECONDERS: W. I. Truettner*, A. V. Brewer*.

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MICHAUD, R. L., Jr. Mech. Engr., Richard W. Evans. PROPOSERS: R. W. Evans, W. E. Jahn. SECONDERS: S. B. Gruenberg, W. A. Backstrom*.

MILLER, B. R., Asst. Prof., Notre Dame University. PROPOSERS: J. F. Naylor, Jr., K. E. Schoenherr*. SECONDERS: C. C. Wilcox*, R. J. Schubmehl*.

MILLER, E. C., Engr., United Gas Pipe Line Co. PROPOSERS: M. M. Heller, A. H. Otto. SECONDERS: B. Segall, R. M. Hood.

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RAINEY, R. W., Bldg. Engr., United Gas Pipe Line Co. PROPOSERS: A. H. Otto, R. M. Hood. SECONDERS: M. M. Heller, E. J. Kearby.

RHODES, C. L., R. J. Smith, Inc. PROPOSERS: R. J. Martin*, J. R. Carroll, Jr. SECONDERS: R. M. Wright*, H. D. Bareither.

RICHARDSON, W. N., Student, Michigan College of Mining & Technology. PROPOSERS: F. E. Wittig, E. L. Sitz*. SECONDERS: W. C. Polkinghorne*, E. P. Weidenhoefer*.

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ROMINE, R. T., Student, University of Michigan. PROPOSERS: Axel Marin, F. N. Calhoun. SECONDERS: C. F. Kessler, A. B. Epple.

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SULLIVAN, J. A., Sales Mgr., Warden-King, Ltd. PROPOSERS: S. W. Salter, H. E. Blatherwick. SECONDERS: A. B. Madden, Leo Garneau.

TAXON, P. L., Partner, Taxon Heating & Air Conditioning Co. PROPOSERS: R. W. Booth, C. J. Braatz. SECONDERS: R. S. Stover, V. M. Lathers.

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VANDERGON, D. L., Grad. Student, University of Minnesota. PROPOSERS: A. B. Algren, R. C. Jordan. SECONDERS: William Sturm, C. E. Gausman.

WARD, E. W., Student, Norwich University. PROPOSERS: W. D. Emerson*, R. A. Loebl*. SECONDERS: D. L. Snader*, L. E. Dix*.

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WATTERS, R. L., Student, A. & M. College of Texas. PROPOSERS: W. E. Long, G. R. Tippett. SECONDERS: W. I. Truettner*, A. V. Brewer*.

WAY, W. J., 2nd, Partner, Way Engineering Co. (*Advancement*) PROPOSERS: Norman Way, E. G. Floeter, Jr. SECONDERS: R. H. Wittbold, E. J. Stansbury.

WEATHERSTON, R. N., Mech. Engr., Pierre Aircon, Inc. PROPOSERS: William Sturm, J. R. Peterson. SECONDERS: J. A. Rudberg, R. E. Ruud.

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ZIMMERMAN, F. E., Engr., C. E. Crone Co. PROPOSERS: C. E. Crone, W. A. Kuechenberg. SECONDERS: M. J. Bamond, H. G. Chapin.

Candidates Elected

JOURNAL SECTION

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by **Art. B-III**, *Section 8*, of the By-Laws, the following list of candidates elected:

Members

BELFORD, L. DU B., Regional Mgr., Air Cond. Controls Div., Minneapolis-Honeywell Regulator Co., New York, N. Y. (*Advancement*)

BENNETT, D. F., Sales Mgr. Radiation & Unit Heater Div., Warren Webster & Co., Camden, N. J.

BERG, H. O., Pres., H. O. Berg Co., Inc., Hammond, Ind.

BERGTHOLDT, G. C., Chief Engr., The Webster Engineering Co., Tulsa, Okla.

BLACKMORE, J. J., Mfrs. Agent, St. Louis, Mo. (*Advancement*)

BODANZKY, H. R., Chief Engr., Starco, Ltda. Sao Paulo, Brazil.

BOLLMAN, R. T., Service & Installation Mgr., Minneapolis-Honeywell Regulator Co., Baltimore, Md.

BRINEN, P. F., Proj. Engr., Young Radiator Co., Racine, Wis.

BROWN, G. W., Vice Pres. & Sales Mgr., Southern Furnace & Supply Co., Houston, Tex.

BUTTERWORTH, J. F., Staff Engr., Socony-Vacuum Oil Co., Inc., New York, N. Y.

CARPENTER, J. H., Mgr. Engrg. Training, Carrier Corp., Syracuse, N. Y. (*Reinstatement*)

CARRASCO, S. Pres., Soclima, S. A. C. (Inc.) Santiago, Chile.

CHRISTMANN, W. F., Engr., Kroeschell Engineering Co., Chicago, Ill. (*Advancement*)

DETRICH, R. C., Chief Engr., The Pyramid Co., Inc., Seattle, Wash.

DE VINES, H. L., Sr. Engr., Reg F. Taylor, Cons. Engr., Houston, Tex. (*Advancement*)

DIETZE, J. B., Engr., Fellheimer & Wagner, Archts. & Engrs., New York, N. Y.

DRAKE, W. L., Chief Engr., Air Temperature Inc., Memphis, Tenn.

DRING, R. W., Mgr. & Partner, R. W. Dring & Son, La Porte, Ind. (*Advancement*)

DUCKETT, A. A., Owner, A. A. Duckett, Inc., Camden, N. J.

FENSTERMAKER, W. R., Sales Engr., John J. Nesbit, Inc., Indianapolis, Ind. (*Advancement*)

FURY, C. O., Southern Dist. Sales Mgr., Clarage Fan Co., Atlanta, Ga.

GLEESON, W. E., Dist. Mgr., McDonnell & Miller, Inc., Aptos, Calif.

GLICKMAN, Nathaniel, Asst. Prof. Medicine & Res. Physiologist, University of Illinois Medical School, Chicago, Ill.

GRAU, E. R., Engr., E. G. Snyder Co., Inc., Rochester, N. Y. (*Advancement*)

GRAY, J. E., Development Engr., Mueller Brass Co., Port Huron, Mich.

HARROWER, W. C., Mgr. Htg. Engrg., Timken Silent Automatic, Jackson, Mich. (*Advancement*)

HERSHBERGER, C. A., Engr., C. R. Eccles & Co., Stockton, Calif.

HOOD, R. M., Managing Partner, Shreveport Refrigeration & Appliance Co., Shreveport, La.

KETTERSON, F. A., Mech. Engr., Stevens & Wilkinson, Inc., Atlanta, Ga.

KIESEWETTER, F. H., Design Engr., Emery Industries, Inc., Cincinnati, Ohio.

LOMAX, BURT, JR., Burt Lomax, Jr., Cons. Engr., Jackson, Miss.

MARCHAL, P. R., Pres. & Gen. Mgr., Societe Ameliorair, Courbevoie, France.

MCELGIN, J. W., Chief Engr., John J. Nesbitt, Inc., Philadelphia, Pa. (*Advancement*)

MC LEOD, D. E., Mech. Engr., Roselyn & Gartner, Archts.-Consultants, San Francisco, Calif.

MCMURRIN, J. C., Owner, Dunham Heating Service of Dallas, Dallas, Tex.

MILLS, D. B., Sales Engr., The Knapp Supply Co., Muncie, Ind.

MILLS, R. H., Engr., Ford Motor Company, Dearborn, Mich.

MURPHY, D. C., Owner, D. C. Murphy Co., Inc., Des Moines, Ia. (*Advancement*)

MYERS, C. A., Sales Mgr. & Engr., Thermo-o-trol Div., Alexander Schroeder Lumber Co., Houston, Tex.

NATION, OSLIN, Mfrs. Repr., Dallas, Texas. (*Advancement*)

NEIL, F. M., Vice Pres., Marshall, Neil & Howard, Inc., Houston, Tex.

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RIDDLE, K. L., Industrial Equip. Engr., Blaw-Knox Co., Pittsburgh, Pa. (*Advancement*)

ROADS, W. C., W. C. Roads, Cons. Engr., Tulsa, Okla.

ROBESON, B. P., Chief Engr., Columbia Specialty Co., Chevy Chase, Md. (*Advancement*)

SCHNEIDER, C. H., Br. Mgr., Ilg Electric Ventilating Co., Pittsburgh, Pa. (*Advancement*)

SHEFFIELD, E. B., Mathers & Haldenby, Archts., Toronto, Canada. (*Reinstatement*)

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ALLBRECHT, C. N., Sales & Gen. Mgr., Bond Supply Co., Battle Creek, Mich.

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BLACK, S. C., JR., Mech. Engr., Parr & Aderhold, Architects, Oklahoma City, Okla.
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NELSON, F. H., Asst. Engr., C. T. Baker, Cons. Engr., Atlanta, Ga.

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SELBERG, R. E., Jr. Engr., J. Donald Kroeker, Cons. Engr., Portland, Ore.

SPOONER, G. F., Dist. Mgr., General Blower Co., Chicago, Ill.

STILES, W. R., Hall-Neal Furnace Co., Indianapolis, Ind.

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TESSMAN, M. O., JR., Jr. Engr., Dallas Air Conditioning Co., Dallas, Tex.

WEISBERG, S. S., Supervising Engr., Weisberg Plumbing & Heating Co., West New York, N. J.

WILSON, N. W., Asst. Mgr.-Sec'y, Larry Harrington Co., Inc., Portland, Ore.

YAMAS, G. J., Sales Engr., Parker Building Specialties, Inc., San Francisco, Calif.

ZIVI, S. M., Engr., Kennard Corp., Brentwood, Mo.

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ARANT, H. D., Student, A. & M. College of Texas, College Station, Tex.

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TIMMERMAN, L. B., Student, Purdue University, W. Lafayette, Ind.

WALKER, W. E., Student, A. & M. College of Texas, College Station, Tex.
WALLBILLICH, J. J., JR., Student, Purdue University, W. Lafayette, Ind.
WILSON, R. W., Student, Purdue University, W. Lafayette, Ind.
WRIGHT, J. W., Student, Michigan College of Mining & Technology, Houghton, Mich.

YERKOVICH, L. A., Student, Michigan State College, Lansing, Mich.

H. G. RICHARDSON DIES SUDDENLY

Henry G. Richardson, Salt Lake City, Utah, passed away suddenly on May 3, 1948. Mr. Richardson joined the Society in 1934 and was the first president of the Utah Chapter, having been one of its organizers. He also served as a member of its Board of Governors for a number of years. At the time of his death he was serving as a member of the Society's Nominating Committee.

Born in Salt Lake City, March 24, 1887, Mr. Richardson attended the University of Utah, receiving his B. S. degree in mining in 1911. During his college career he was noted for athletic prowess, particularly in football and track. His record in football, basketball and track at the University still is a campus conversation topic. He became athletic coach for Salt Lake High School, an activity he continued until 1918.

In 1918 the firm of Hawley-Richardson-Williams Co. was established specializing in heating, ventilating and air conditioning work. Mr. Richardson served as vice president of this firm and later he became a partner in the firm of Williams-Richardson Co., serving for a number of years as president.

Mr. Richardson was a member of the Church of Jesus Christ of Latterday Saints.

Besides his widow, he is survived by four daughters, two sons, a brother, a sister, and four grandchildren, to whom the officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sincerest sympathy.

R. B. JENNINGS' DEATH SUDDEN

Word has been received of the death of Robert B. Jennings, district manager, The Trane Co., Columbus, Ohio.

Mr. Jennings was born on May 7, 1901 at Columbus, Ohio, where he attended the North High School. He received a degree in civil engineering from Ohio State University in 1925. His first assignment was with the Jennings-Lawrence Co., Columbus, working on surveying and civil engineering. Later in 1925 he became assistant division engineer for the C & O railroad. In 1926 he was chief designing engineer for the City of Columbus. He joined The Trane Co. in 1938 as manager of the Columbus office, in charge of engineering, heating, ventilating and air conditioning equipment.

During the war he served as commander (E.C.) U. S. Naval Reserve on active duty. Following the war he returned as manager of the Columbus office of The Trane Co.

He joined the Society in 1946 and was a member of the Central Ohio Chapter.

The Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sympathy to his family.

MEMBER FOR HALF CENTURY DIES IN ENGLAND

J. Nelson Russell, Life Member of the ASHVE since 1937, passed away on April 28, 1948. Mr. Russell, although he lived in England, always took an active interest in the Society and attended several of its Annual Meetings.

Mr. Russell was born in London on January 6, 1870, and attended home schools there. Upon graduation from the Finsbury Technical College in 1887, he was apprenticed to the firm of Rosser and Russell, specialists in heating and ventilating. In 1894 he became director of the firm. Although Mr. Russell had been retired for three years, he was chairman of the company until his death.

Elected to membership in the Society in 1889, Mr. Russell was one of its oldest members. In 1934 he made a trip to the United States visiting several local chapters and attending their meetings. In some instances he gave an account of the differences between the English and American heating and ventilating practices.

The Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sincere sympathy to his family for their great loss.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL SECTION

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*Member of Committee on Research.

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Central New York: Organized 1944. Headquarters, Syracuse, N. Y. President, D. L. Mills, 1407 N. Madison St., Rome. Secretary, J. H. Carpenter, 3515 Midland Ave., Syracuse 7.

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Kansas City: Organized, 1917. Headquarters, Kansas City, Mo. Meets First Monday. President, H. E. Gould, 1924 Oak Rd., Kansas City 8. Secretary, K. M. Stevens, 1510 Main St., Kansas City.

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Manitoba: Organized, 1935. Headquarters, Winnipeg, Man., Canada. Meets, Second Thursday. President, J. R. Stephenson, 278 Main St., Winnipeg. Secretary, D. F. Michie, 278 Main St., Winnipeg.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, R. T. Kern, 51 Claflin St., Leominster. Secretary, D. W. Blair, 59 Frost St., Cambridge.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, E. E. Scott, 918 Dermon Bldg., Memphis 3. Secretary, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets. First Monday after 10th of month. President, E. F. Hyde, 708 Oakland Ave., Birmingham. Secretary, J. H. Spurgeon, 5050 Joy Rd., Detroit 4.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, O. L. Lilja, 5000 16th Ave., S., Minneapolis 7. Secretary, E. F. Snyder, Jr., 4324 Zenith Ave., N., Minneapolis 12.

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New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, A. A. Bearman, 444 West 56th St., New York 19. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, E. S. deWitt, 1211 Commercial Bank Bldg., Charlotte. Secretary, R. M. Warren, Jr., 1001 N. Church St., Charlotte 1.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, B. S. Foss, Jr., 711 Construction Bldg., Dallas 1. Secretary, Herman Blum, Jr., 2812 Fairmount St., Dallas 4.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, John James, 3170 W. 106th St., Cleveland 11. Secretary, W. M. Rowe, 1302 Swetland Bldg. Cleveland 15.

Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, J. H. Spaan, Jr., 1303 N. Klein, Oklahoma City 6. Secretary, J. R. Patten, 627 N.W. Second St., Oklahoma City.

Ontario: Organized, 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. President, E. G. Spall, 73 Simcoe St., Toronto 1. Secretary, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, E. R. Lokey, 1238 N. W. Glisan St., Portland 9. Secretary, A. N. Hoss, 621 S. W. Alder, Portland.

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Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, L. L. Bysom, 1214 Eighth St., Bremerton. Secretary, D. O. Mead, 816 Arctic Bldg., Seattle 4.

Philadelphia: Organized, 1916 Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, J. O. Kirkbride, Fourth & Locust Sts., Philadelphia 6. Secretary, M. E. Barnard, 12 S. 12th St., Philadelphia 7.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, H. E. Park, 201 E. Carson St., Pittsburgh 19. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

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Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, Fred Janssen, 1123 W. Third Ave., Denver 9. Secretary, F. C. Allen, 4467 King St., Denver 11.

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St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, B. L. Evans, 571 Stratford Ave., University City. Secretary, C. H. Burnap, 1635 Syndicate Trust Bldg., St. Louis 1.

Shreveport: Organized 1948. Headquarters, Shreveport, La. President, W. E. FitzGerald, 939 Louisiana Ave., Shreveport. Secretary, O. J. Dykes, Jr., 1012 Market St., Shreveport.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, C. C. Quin, 809 Stuart Ave., Houston 6. Secretary, R. J. Salinger, 4510 Dewberry Lane, Houston 4.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. President, R. S. Farr, 2615 Southwest Dr., Los Angeles. Secretary, L. J. Helms, 633 S. Berendo St., Los Angeles 5.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, F. C. Benham, Jr., 702 S. Flores St., San Antonio Secretary, L. S. Pawkett, 810 Insurance Bldg., San Antonio 5.

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Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, E. V. Gritton, 2470 S. 15th, Salt Lake City 5. Secretary, C. E. Ferguson, 838 Garfield Ave., Salt Lake City.

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Virginia: Organized, 1946. Headquarters, Norfolk, Va. Acting President, J. E. White, 7607 Gloucester Ave., Norfolk 5. Secretary, D. E. Phillips, P. O. Box 674, Newport News.

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Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, A. S. Gates, Jr., 621 N. Jackson St., Arlington, Va. Secretary, J. G. Muirheid, 2013 New Hampshire Ave., N. W., Washington 9.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, H. W. Wolters, 820 Staples Ave., N.W., Kalamazoo 54. Secretary, C. V. Saunders, P. O. Box 671, Kalamazoo 99.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, Edwin Woolcock, 2217 15th St., Niagara Falls, N. Y. Secretary, T. F. Killeen, 374 Delaware Ave., Buffalo 2.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, W. A. Ouweneel, 514 E. Ogden Ave., Milwaukee 2. Secretary, H. F. Brinen, 2226 Kinzie Ave., Racine.

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North Carolina State College: Organized 1948. Headquarters, Raleigh, N. C. President, J. G. Marshall, North Carolina State College. Secretary, Basil Greene, Apt. D-2, Grosvenor Gardens Apts., Raleigh.

Purdue University: Organized 1948, Headquarters, W. Lafayette, Ind. Chairman, R. G. James, 411 E. 37th St., Indianapolis. Secretary, H. H. Clark, Jr., 519 State St., W. Lafayette.

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, S. E. Ammons, 212 13th Ave., No., Texas City. Secretary, C. P. Howard, Box 1706, College Station.

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For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1948 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

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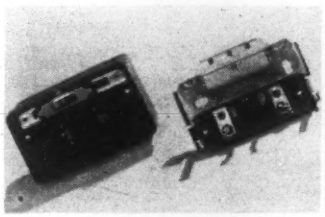
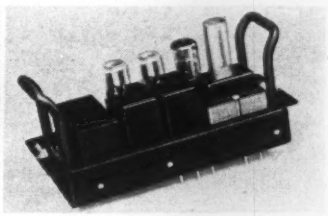
Designed for use in heating, ventilating, and cooling in factories, offices, and commercial buildings, the system includes a room thermostat, duct and immersion thermostats, an electronic modulating motor, and an electronic relay. Additional thermostats and motors may be added to the system in accordance with the size of the area under control. Shown here are an interior view of





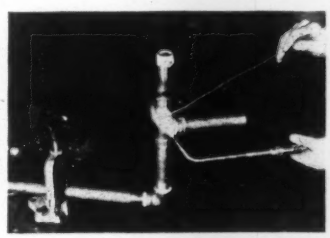
the thermostat (left) and the electronic relay.

Flexibility and simplicity are said to be important advantages. Single thermostats can be used for both heating and cooling, with automatic changeover from one to the other at any selected temperature level. Averaging thermostats may also be added to the system. Another important feature, says the company, is the ease with which compensators may be added to change inside temperatures in accordance with outdoor temperatures.

Essentially, the controls operate on changes in the electrical resistance (due to temperature changes) of a small coil of wire. The relay, which is said to interpret the changes in hundredths of a degree, amplifies the current to the control motor.

Develops Brazing Fitting for IPS Brass and Copper Pipe

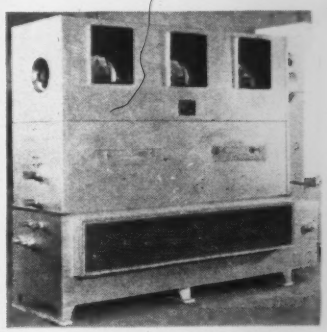
No. 3795 — "Flagg-Flow" bronze pipe fittings for brazing to IPS brass or copper base alloy tubing or pipe and designed for 150 lb working steam pressure at 450 F or 300 lb pressure for nonshock cold water, oil, or gas lines, has been developed by Stanley G. Flagg & Co., Inc., 1421 Chestnut St., Philadelphia 2, Pa.



The manufacturer states that this line of fittings tends to reduce turbulence, as the internal diameter is the same as the inside diameter of the pipe or tubing. Close tolerances in the machining of the cups are said to insure rigid support and a thorough bond.

Among numerous applications, the fittings are recommended for use in concrete and cinder fill flooring (as in radiant heating) and because of their relatively small overall dimensions, they are said to be ideal for use in thin wall partitions.

Announces New Design of Conditioners Evaporative Condensers, Water Coolers



No. 3796 — The Model F design of evaporative condensers, evaporative water coolers, and vertical air conditioning cabinets has been announced by Buffalo Forge Co., Buffalo 5, N. Y.

The evaporative condensers (shown here) are designed to use make-up water at a rate not exceeding 0.03 gpm per ton of refrigeration. Both ammonia and "Freon" types are offered.

Available in sizes from 2000 to 22,000 cfm of conditioned air, the conditioners can be used in combinations for simple cooling or complete air conditioning.

The evaporative cooler may be used for cooling jacket water from diesel and natural gas engines, air compressors, and other machines, as well as for lubricating and quench oils. Controls for the automatic regulation of liquid temperatures are available. Capacities range from 20 to 600 gpm of cooling water.

Features of all units are said to include a new aluminum blower wheel that is stable over a wide range of capacity and pressure.

Heating, Piping & Air Conditioning **[7-48]**
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

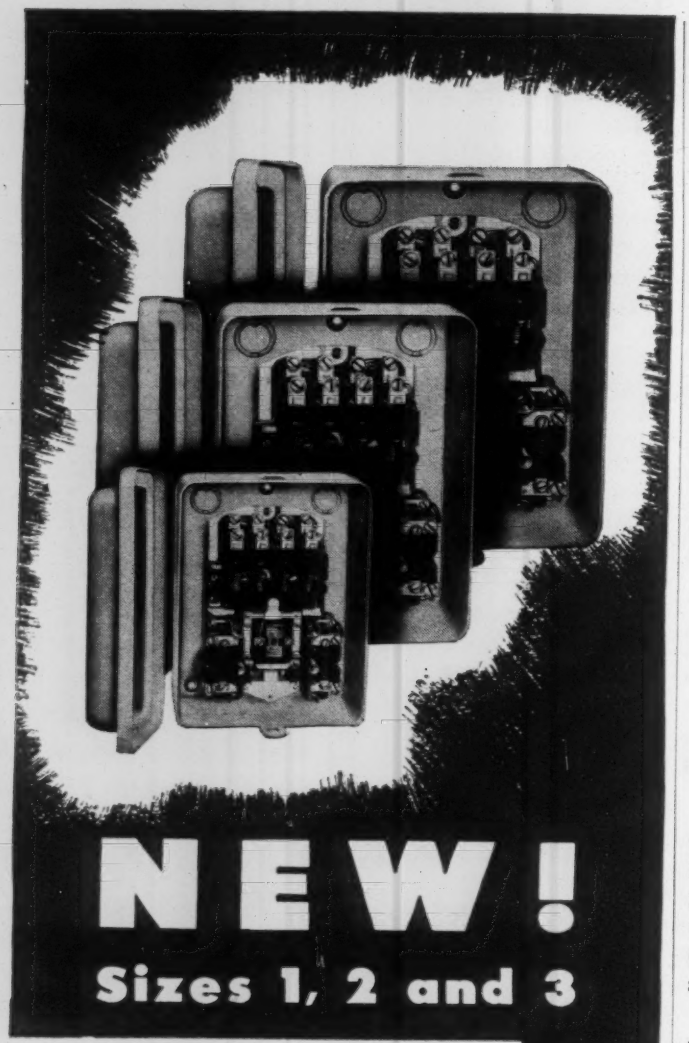
3794	3795	3796	3797	3798	3799	3800	3801	3802	3803
3804	3805	3806	3807	3808	3809	3810	3811	3812	3813
3814	3815	3816	3817	3818	3819	3820	3821		
6887	6888	6889	6890	6891	6892	6893	6894	6895	6896
6897	6898	6899		6901	6902	6903	6904	6905	6906
6907	6908	6909	6910	6911	6912	6913	6914	6915	6916

Name ..... Title.....

Company .....

Address .....

City ..... Zone..... State.....



NEW!

Sizes 1, 2 and 3

Ward Leonard a-c Magnetic Starter Is Small in Size, Big in Performance

For fast, positive, dependable across-the-line starting of non-reversing motors, install Ward Leonard 4110 a-c Magnetic Starters.

Unit construction. Open or enclosed type. Accessible components. Double-break silver-to-silver main contacts. Thermal relays give overload protection. Local or remote control.

Ward Leonard Starters are "Result-Engineered." By modifying a basic design, Ward Leonard can give you the results of a special . . . for the cost of a standard.

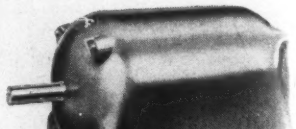
Write for Bulletin 4110. Ward Leonard Electric Co., 24 South St., Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WHERE BASIC DESIGNS IN ELECTRIC CONTROLS ARE RESULT-ENGINEERED FOR YOU

WARD LEONARD ELECTRIC COMPANY

RESISTORS · RHEOSTATS · RELAYS · CONTROL DEVICES

Designs Motor for Sanitary Use



No. 3797—A new sanitary motor, streamlined and free of cracks or depressions, has been developed by Louis Allis Co., Milwaukee 7, Wis.

Offered for use in dairies, food processing, canning, and beverage plants, the motors can be washed down to insure maximum sanitation. The entire base is enclosed by the motor housing which is finished to a flat surface. This, says the manufacturer, prevents the collection of milk or food particles under the motor. Motors of the smaller ratings will be supplied in the totally enclosed, nonventilated construction. Larger units are of the splashproof type and will be supplied with removable stainless steel grille plates over the cooling air inlets and outlets.

The motor will be supplied with the type C flange for pump applications and for all of the standard and special voltages, frequencies, and electrical modifications that may be encountered.

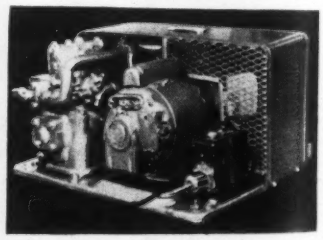
Line of Bronze Gate Valves Features Interchangeability

No. 3798—A new line of 150 lb bronze gate valves has been announced by Lunkenheimer Co., Waverly & Beekman Sts., Cincinnati 14, Ohio. The valves are made in three types: a double disc unit, a solid disc type, and a nonrising stem valve.

All of these valves are equipped with the company's patented alloy stems which are said to provide remarkable resistance to wear and to minimize stem thread failures. The three types are largely interchangeable, as only different trim is required to convert from one type to another.

Screw end valves are rated 150 lb steam pressure, 300 lb for water, oil, or gas; flange end valves at 150 lb SP, 225 lb WOG.

Small Unit Removes Moisture in Rooms



No. 3799—Production of a new, low cost "Humidry" dehumidifier, said to be capable of removing 34 pints of water a day from the atmosphere of a normal sized room in a humid climate, has been announced by Carrier Corp., 302 S. Geddes St., Syracuse 1, N. Y.

Operating on a 1/3 hp motor, it can be used in all climates where dampness and humidity cause deterioration and discomfort. Other uses include the prevention of rust on valuable tools and the preservation of permanent records in vaults. It can be plugged into an ordinary electrical outlet, and the only pipe connection used is for running moisture down a drain.

Develops Glass Insulation for Hot or Cold Ducts

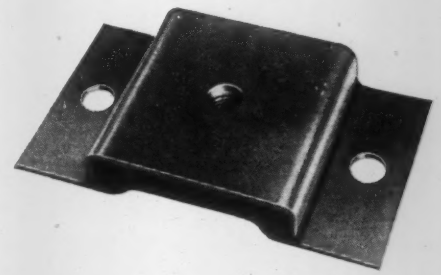
No. 3800—Owens-Corning Fiberglas Corp., Nicholas Bldg., Toledo 1, Ohio, has developed two glass materials for the insulation of ducts.

The coated duct insulation, for hot or cold ducts, is a lightweight material in board form with a coating on both surfaces. It can be cut with a knife to conform to irregular shapes and curved surfaces and can be scored to take a sharp bend. The coating can be painted or covered with asbestos or canvas. Thermal conductivity is said to be 0.26 at 75 F mean temperature. The density is 6 lb per cu ft.

The new flexible insulation, also for hot or cold ducts, is uncoated and is designed for use in concealed places where finish is not important. Two densities and weights are available, and thermal conductivities range from 0.23 to 0.25 at 75 F mean temperature.

The manufacturer states that both types will dry out rapidly if wetted, with the original efficiency unimpaired. In the accompanying illustration, the insulation joints are being covered with "Fiberglas"-backed industrial adhesive tape which is said to help hold the insulation in place.

Uses Synthetic Rubber in Vibration Mounting



No. 3801 — The "Shockmount," recently announced by Lord Mfg. Co., Erie, Pa., is designed to control shock, isolate high frequency vibration, and reduce noise transmittance to the floor. It is a heavy duty mounting with load capacities up to 7500 lb per mount.

According to the company, the new unit reduces the need for massive foundations to achieve inertia, and it permits the placing of heavy machines where it would otherwise be impractical. The flexing element is synthetic rubber and the top plate contour is designed to limit movement and to shed oil and dirt.

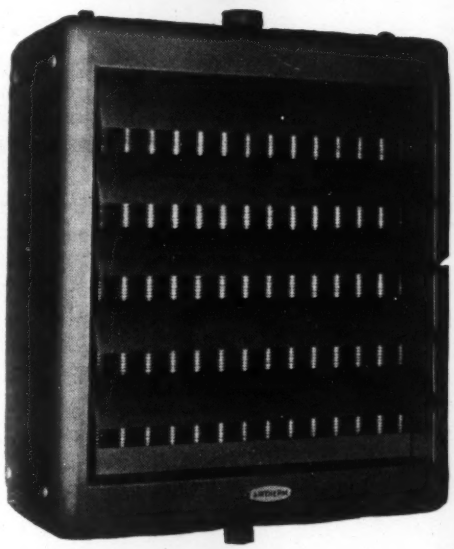
Oil Fired Unit Heater Is Self-Contained

No. 3802—The "Thermobloc" direct fired heater, recently announced by Thermobloc Div., Prat-Daniel Corp., East Port Chester, Conn., has been designed to deliver 550,000 Btu per hr, to burn No. 3 fuel oil, and to operate at 80 to 85 percent efficiency.

It is completely automatic and after fuel, electrical, and exhaust gas connections are made, is ready for operation.

You Can Safely Recommend

AIRTHERM
STEAM UNIT HEATERS
FOR OUTSTANDING PERFORMANCE



1. High over-all efficiency.
2. Attractive in design and rugged in construction.
3. Copper heating elements in floating suspension.
4. Resiliently mounted motors for smooth and quiet operation.
5. Capacities from 26,000 to 274,000 BTU per hour.

There's an Airtherm Steam Unit Heater for every heating application. Write for Bulletin 1206 giving detailed information and range of available sizes.

IT'S WISE TO BUY FROM YOUR DISTRIBUTOR...
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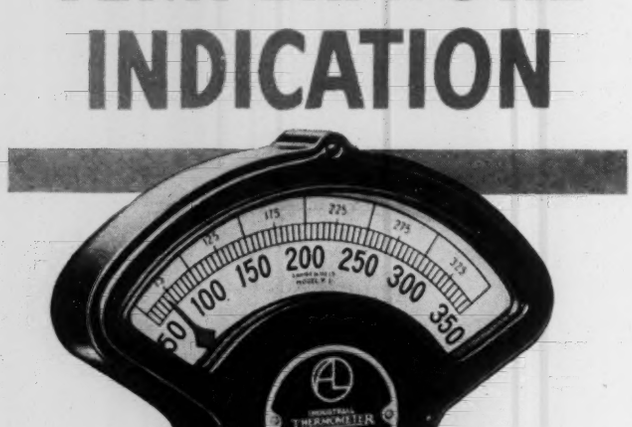
DIRECT FIRED HEATERS | PROPELLER FAN STEAM UNIT HEATERS | BLOWER FAN STEAM UNIT HEATERS | CONVECTOR RADIATION

ACCURATE

TEMPERATURE INDICATION



Model F-1 Indicating Thermometer, priced from $22. Other styles & types available. Send for catalog.

The large, easily-read dial on this Auto-Lite Indicating Thermometer simplifies temperature observation. Equipped with flexible capillary tubing, readings can be made at convenient distance from the temperature source. The pointer is connected directly to the bourdon spring for accurate, efficient one-to-one ratio movement. Sturdy construction eliminates delicate parts. Choice of standard chart ranges.

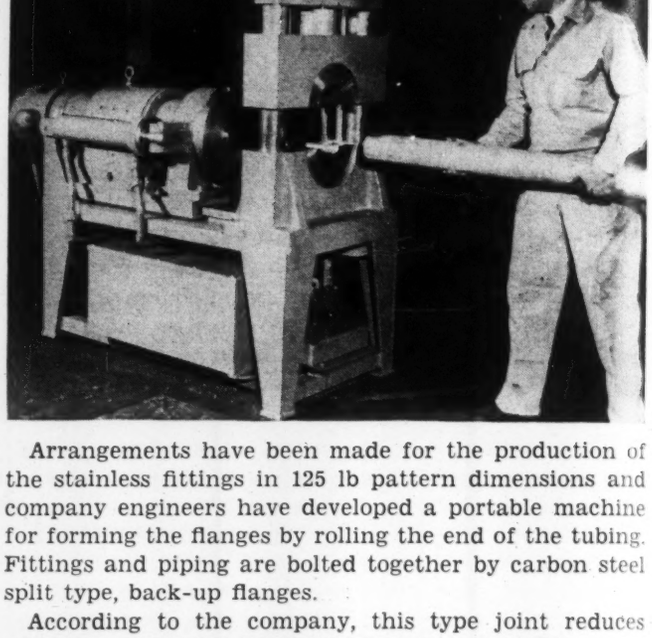
THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION • TOLEDO 1, OHIO
New York - Chicago - Sarnia, Ontario

AUTO-LITE

INDICATING & RECORDING THERMOMETERS

Uses Vanstone Joints on Stainless Steel Tubing

No. 3803—According to a recent announcement, H. K. Ferguson Co., Hanna Bldg., Cleveland, Ohio, industrial engineering and building firm, has perfected the use of lightwall stainless steel Vanstone-end fittings with lightwall stainless steel tubing which can be cold-Vanstoned in the field.



Arrangements have been made for the production of the stainless fittings in 125 lb pattern dimensions and company engineers have developed a portable machine for forming the flanges by rolling the end of the tubing. Fittings and piping are bolted together by carbon steel split type, back-up flanges.

According to the company, this type joint reduces maintenance and replacement costs materially, especially when corrosion is a factor, and is expected to increase the use of stainless piping systems in chemical food processing, and other types of industrial plants.

It is also said that test results indicate that extreme work hardening, as a result of the cold Vanstone process, is a factor which can be ignored.

In the illustration, a section of 6 in. lightwall stainless tubing is being placed in the machine, preparatory to flanging.

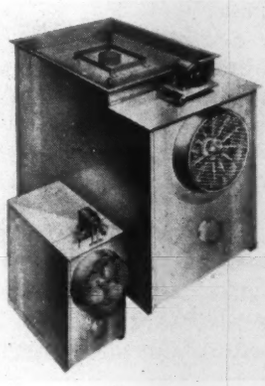
Aluminum Insulation Made Up to Form Reflective Surfaces, Air Spaces

No. 3804**—Aluminum insulation of the "accordian" type which is available for installation on 16 and 24 in. centers and which has two rows of alternating, reverse, triangular shaped air spaces, is being produced by Infra Insulation, Inc., 10 Murray St., New York City.

This insulation is shipped folded in cartons and when installed, occupies a 1½ in. space. The reflective surface consists of pure aluminum and the spacing foundation is either Kraft paper or asbestos. When open, one outer surface of the insulation is completely flat and the other side is peaked at the ends. The 2 in. flanges along both sides are nailed or stapled into the beams or studs. The manufacturer recommends that it be placed 2 or 3 in. above the beams when installed from below in order to provide two additional reflective air spaces, one above and one below the insulation. Installation between steel beams and trusses is the same as for wood beams except that the insulation is laid on wires strung between the trusses, and flanges are clipped together with a stapler.

High resistance to heat flow, particularly radiant energy, and its effectiveness as a vapor barrier, together with its being fireproof, moldproof, and verminproof are said to be outstanding advantages.

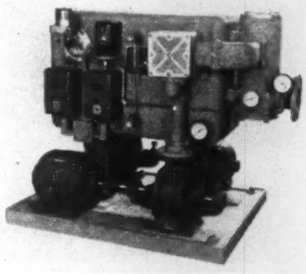
Redesigns Water Cooling Tower for Indoor, Outdoor Use



No. 3805—The "Aquatowers" offered by Marley Co., Inc., Kansas City 15, Kans., have been redesigned and are available in sizes from 3 to 50 tons of refrigeration. These water cooling towers are now a packaged product.

Construction features include an all welded steel casing, aluminum fans, and nail-less redwood filling. Units may be used for either indoor or outdoor service and are shipped completely assembled.

Creates Vacuum for Heating System and Returns Condensate to Boiler



No. 3806**—The "Multi-Jet" dual vacuum return pump has been designed by Faber Engineering Co., Inc., Amber and Westmoreland Sts., Philadelphia, Pa., to create a vacuum and to return condensate to the boiler in vacuum heating systems.

Two separate motor driven turbine pumps are used; one to provide the hydraulic power for the multiple ejectors which are used to create the vacuum and the other to return the condensate against any boiler pressure. Except for the turbine rotors of these pumps, the unit has no other moving parts. According to the manufacturer, high efficiency, reliability, low power consumption, and adaptability to any vacuum heating return system are outstanding features.

Copper or Aluminum Fins Available on Copper Tubing

No. 3807* — Merchant & Evans Co., 2035 Washington Ave., Philadelphia 46, Pa., has announced a line of finned tubing for use in many industries, particularly in the manufacture of steam coils, heat exchangers, heat reclaimers, condensers, and other heat transfer devices.

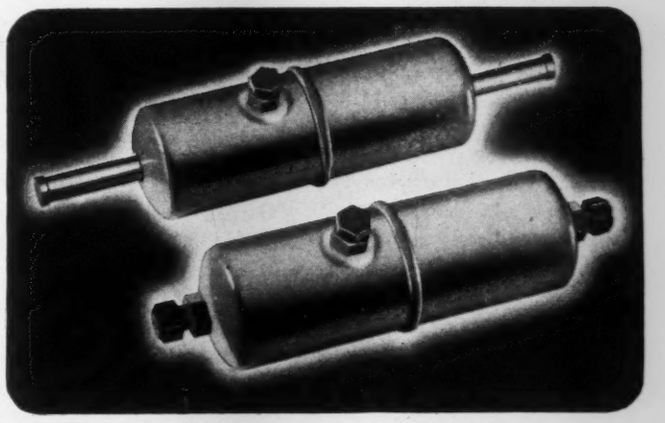
Long or short lengths of 5/8 in. OD copper tubing can be furnished with copper or aluminum fins spaced three to seven per inch. The outside diameter of the fins is either 1 3/8 or 1 5/8 in.

According to the company, the fins are designed, not only to have a wide contact area, but also to maintain constant spring tension against the tubing. Parts can be fabricated or assembled to meet specific requirements.

NOW... Keep Larger Systems Moisture-Free, Dirt-Free ...

Install New Large-Capacity, Rechargeable

TRAP-DRI DRIER FILTER STRAINER

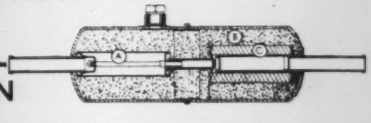


● With a rating of up to 5 tons Freon these new larger A-P TRAP-DRI Drier-Filter-Strainers give you a welcome "break" on cleaning out larger systems, as well as providing for those small systems which need a larger capacity drier for preliminary cleanout. Now all your systems up to 5 tons Freon may be given the *extra protection* that means so much to improved system efficiency, avoidance of common troubles and service difficulties due to moisture, dirt, solder particles, scale, sludge and other impurities.

The new larger A-P TRAP-DRI starts cleaning up your system immediately. Offering *minimum pressure drop*, it provides a filter unit as effective as a 900-mesh strainer (removing materials as small as 5 microns in size) . . . *plus* a highly-efficient and adequate charge of Silica Gel —53.7 cubic inches. This *drying agent may be removed and replaced, or dried out and re-used.*

Install the new A-P TRAP-DRI in your larger refrigeration systems — for improved operation, savings in service time, greater satisfaction and cost-savings for your customers. You'll find them at leading refrigeration wholesalers — or write for latest bulletins.

VERSATILITY IN INSTALLATION



The new TRAP-DRI is supplied in two types: Model DF-4, with 1/2" male flare; or DS-5, with 5/8" sweat connection. They may be easily connected to 3/8", 1/2", 5/8", 3/4" or even 7/8" tubing if desired. This ready versatility makes the new TRAP-DRI adaptable to a wide variety of systems.

Cross Section showing:
(A) Screen at inlet diffuses refrigerant into Silica Gel.
(B) Silica Gel drying agent (53.7 cu. in.)
(C) Honeycomb filter element traps impurities as small as 5 microns, by depth filtration principle.

AUTOMATIC PRODUCTS COMPANY
2460 North Thirty-Second Street
Milwaukee 10, Wisconsin
Export Dept., 13 East 40th Street, New York 16, N. Y.

DEPENDABLE REFRIGERANT VALVES

STOCKED AND SOLD BY GOOD REFRIGERATION WHOLESALERS . . . RECOMMENDED AND INSTALLED BY LEADING REFRIGERATION SERVICE ENGINEERS

A SMART NEW
REALLY PORTABLE
Power Drive

New RIDGID Porta-Power Drive operates your hand pipe tools—weighs only 100 lbs.

● Here's easily portable power for you—job-tested Porta-Power weighs only 100 lbs. Modern design light alloy case can't be topped for strength and durability. Universal motor—forward and reverse, light socket operation, turns pipe for your hand threaders, cutters, reamers. RIDGID lathe-type 3-jaw chuck in front, chuck-wrench ejector; self-centering work-holder in rear turns with pipe. Sealed-in lubrication—no oil to spill. Buy at your Supply House.

Easily carried. Bolts to bench. Large handy tool tray when set up as stand.

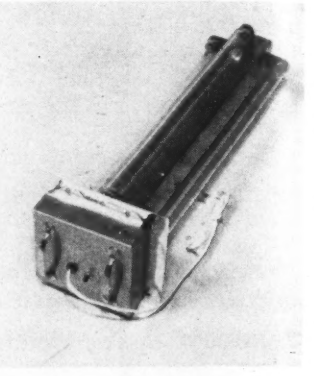
RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

Automatic Valve Eliminates Air From Radiators and Convectors

No. 3808—Automatic air valves for eliminating air from the radiators and convectors of hot water heating systems are now in production at Dole Valve Co., 1843 W. Carroll Ave., Chicago 12, Ill.

Said to represent 10 years of intensive research and development, this No. 16 valve may be set, using a coin or a screw driver, for manual shutoff, automatic elimination of air, or manual venting. Application can be made on either new or existing heating plants.

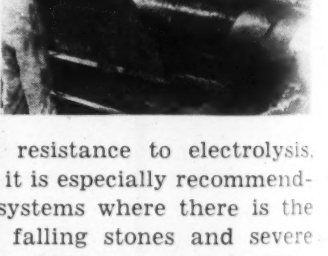
Germicidal Lamps Installed in Heating, Conditioning Systems



No. 3809**—The "Sterilator," a new germicidal lamp unit, may be installed in the ducts of warm air heating and air conditioning systems. According to the manufacturer, Sterilator Div., Coleman-Pettersen Corp., 2130 St. Clair Ave., Cleveland 14, Ohio, it kills 95 to 98 percent of airborne bacteria, cold germs, and infectious germs. Available for homes, industrial plants, and commercial establishments, it is being marketed through wholesalers, dealers, and contractors.

The unit is equipped with a General Electric Co. 4000 hr life germicidal lamp.

Protective Pipe Coating Used on Underground Lines



No. 3810** — "Duratex" protective pipe coating, currently being used by a number of utility and oil companies, is now available to general industry, according to National Petroleum Sales, Inc., 315 W. 9th St., Los Angeles, Calif.

Said to have exceptional resistance to electrolysis, corrosion, and shock impact, it is especially recommended for underground piping systems where there is the possibility of damage from falling stones and severe earth shock or movement. In addition to great ductility and high flash and fire points, the manufacturer states that the material is not appreciably affected by alkalis and soil acids. The ease with which it may be applied and reheated, high tensile strength, and a high bonding characteristic to metal or concrete are said to be other outstanding features.

Electrode Unit Controls Boiler Water Level

No. 3811—A new line of "Electrode" boiler water level controls has recently been announced by Penn Electric Switch Co., Goshen, Ind. Water level in the unit is used to complete the electrical circuit between electrodes.

Three models are available, one for low water cutoff, the second for boiler feed pump service, and the third for combined low water cutoff and feed pump service. Each model consists of an electrode chamber and a relay panel. The relays for the low water cutoff models incorporate an alarm or signal light circuit and are of the manual reset type.

Adapts Compression Fittings to Thermometer Bulbs

No. 3812—A method of adapting compression type fittings to thermometer bulbs has been developed by Manning, Maxwell & Moore, Inc., Bridgeport 2, Conn., so that users may change thermometers originally made with plain bulbs to union connection.

Compression fittings are applied directly to the bulb to produce any desired length up to 6 in. A separable socket may also be provided by welding or soldering a well to the union bushing. According to the company, users may keep their thermometers available and install them wherever necessary by applying the compression fittings in the manner dictated by the needs of the service.

D-C Amplifier Handles Minute Power Impulses

No. 3813—In its "Microsen" amplifier, an instrument designed to measure and amplify minute power impulses as low as 0.2 microvolts, Manning, Maxwell & Moore, Inc., Bridgeport 2, Conn., has introduced a new principle in d-c amplification which is said to make possible an unusual combination of sensitivity and stability.

Power inputs from ionization, photoelectric cells, thermocouples, or a wheatstone bridge are amplified by means of an electro-mechanical balance, giving an output signal directly proportional to the input signal. Input is measured and output stabilized through a feedback circuit. The instrument incorporates a mechanical zero adjustment with sufficient range to permit operation from various reference voltages, an adjustable gain, no lower frequency limit, and low input resistance.

Filters, Humidifies Air in Rooms

No. 3814—Fresh'nd-Aire Co., 221 N. LaSalle St., Chicago 1, Ill., has developed a new model 600 humidifier designed to filter, wash, and moisturize air in rooms.

An electric motor drives a fan and a circulating pump. Water from a three gallon reservoir in the base is pumped to the top of the unit and is forced through a water distributing ring which surrounds the top of the humidifier. The water is discharged through holes in the distributing ring and falls through a fibrous filter, creating, in effect, a circular waterfall through which air is drawn by the fan.

According to the manufacturer, the device disperses over 200 cfm of washed and moisturized air.

THE PIPE VISE
that's your
On-the-Job
WORKBENCH

RIDGID big-tray Tristand
is a cinch to carry and set up anywhere needed

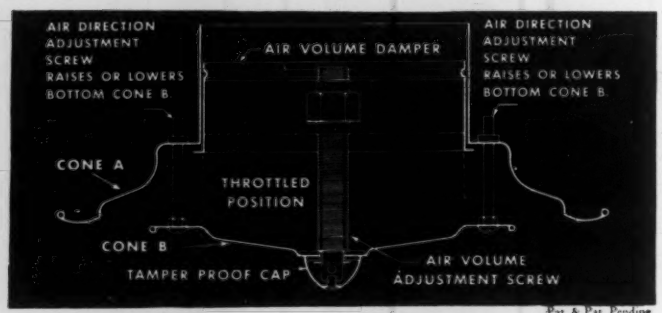
● Much more than just a vise, the popular RIDGID Tristand is really a portable workbench. Hinged legs fold in and chain for carrying; easily set up, tip proof. Roomy stand for dope pot, oil can; special slotted rim for hanging tools; pipe rest and 3 benders that won't dent pipe. Vise has tool-steel LonGrip jaws that provide firm hold, won't mar polished pipe. Chain vise, 4" capacity; yoke vise, 2½." It's a great work-saver en route . . . and on the job. Order from your Supply House.

Tristand Vise—ready to load on your truck.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

How ADJUSTABLE air diffusers increase the efficiency of supply air distribution

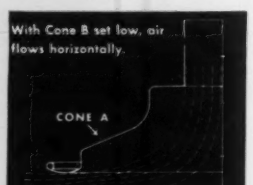
Kno-Draft Adjustable Diffusers offer all the advantages of draftless air diffusion plus fast system balancing and air pattern control


AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B
AIR VOLUME DAMPER
AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B
CONE A
THROTTLED POSITION
CONE B
TAMPER PROOF CAP
AIR VOLUME ADJUSTMENT SCREW

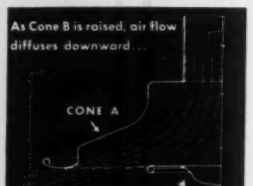
Pat & Pat Pending

Fast System Balancing: Volume damper regulates the air outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

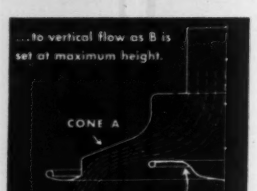
Positive Air Pattern Control: Air direction adjustment affords any angle of air discharge from vertical to horizontal needed to accommodate ceiling heights, individual or seasonal requirements. It can expel chilled air parallel to the ceiling or eject heated air downward to prevent stratification.



Specify Kno-Draft Adjustable Air Diffusers for better mixing control of room and supply air, more uniform temperatures throughout the occupied zone and noiseless, draftless air distribution.

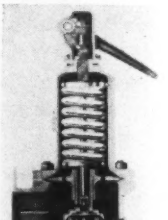


Send for FREE handbook containing sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers. For your copy, please write Dept. D-13 on company letterhead.



W. B. CONNOR ENGINEERING CORP.
AIR DIFFUSION AIR PURIFICATION AIR RECOVERY
112 East 32nd Street New York 16, N. Y.
IN CANADA: Douglas Engineering Co., Ltd., 1405 Bishop St., Montreal 25, P. Q.

High Pressure Safety Valve Handles Corrosive Fluids



No, 3815—Farris Engineering Corp., 494 Commercial Ave., Palisades Park, N. J., is offering a new type of safety relief valve especially designed for handling inlet pressures up to 2000 psi and temperature up to 900 F and for handling corrosive liquids, vapors, or gases.

Designated as type No. 2680, the valve is made of cast steel with stainless steel trim. A high disc lift is designed to permit full capacity discharge. According to the manufacturer, the valve capacity has been certified by actual test at the laboratories of the National Board of Boiler and Pressure Vessel Inspectors.

A modification of the valve has all working parts isolated behind a curtain of rubber or any flexible metal designed to withstand the action of specific acids or caustics. An additional modification consists of steam coils to maintain fluid temperature.

The valve is available in sizes from 1½ x 2 in. to 6 x 8 in.

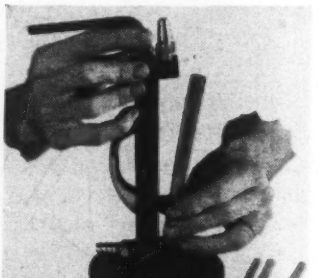
Develops New Vapor Sealer for Refrigerated Equipment

No. 3816—A new improved sealer for use in the insulation of refrigerated equipment (to keep vapor and moisture laden air from the insulation space) has been developed and placed on sale by Armstrong Cork Co., 4400 Concord St., Lancaster, Pa. Called "Sub-Zero Sealer," the new product is said to be resilient, moisture-and-vaporproof, and sufficiently pliable to resist normal impact and torque action.

It may be used in all-steel construction where it is poured along the welded seams and under the breaker strips. In combination wood and steel construction, it is poured along the joints where the wood and steel meet.

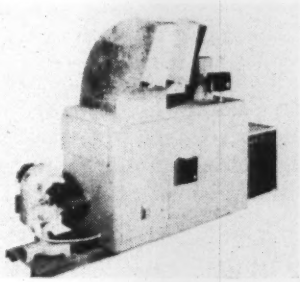
The new product has a melting point of 240 to 260 F and at −10 F a 1/16 in. film of sealer on 30 lb kraft paper can be bent slowly around a 1 in. mandrel without cracking, according to the company.

Offers Laboratory Kit for Determining Flow Rates



No. 3817 — Recently announced by Fischer & Porter Co., Dept. 1J-J, Hatboro, Pa., is a new laboratory kit (rotameter type) designed to fill the need for a versatile and inexpensive flow measurement "set", to meet the varied flow measurement needs of the research laboratory. It consists of a metering tube holder with base plate and hose connectors, four readily interchangeable tubes, and six metering floats complete with calibration data. Capacities from 0.065 to 2200 cc per min of water and 5.0 to 36,800 cc per min of air are covered.

Portable Oil Furnace Offered for Many Commercial Uses



No. 3818 — A compactly designed portable oil furnace for commercial buildings has been announced by Service Metal Fabricators, Inc., 2350 W. 58th St., Chicago.

It is designed for use in heating garages, warehouses, and buildings under construction where it speeds drying of plaster and keeps crews working in cold weather. Other uses include tobacco storehouses, poultry houses, brooder houses, and factories.

It has a jet type gun burner, the nozzle of which delivers 120,000 Btu per hr at the bonnet, and has a free air delivery of 2800 cfm. It is designed to burn No. 3 grade oil or lighter. Controls include a combination fan and limit control, an automatic stack control, and an automatic humidifier.

According to the manufacturer, its design permits using it as a space heater with the plenum mounted on the top of the furnace, or it can be connected to duct work. An air filter is used at the intake.

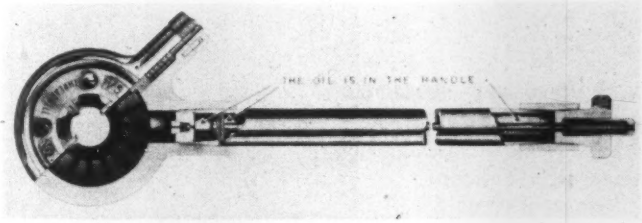
Records Small Physical Motions by Air Pressures

No. 3819—The recording of small physical motions by air pressures is the function of the "Microtrans," now being commercially introduced by Hagan Corp., Hagan Bldg., Pittsburgh 30, Pa.

The unit is designed to translate physical movements of 0 to 0.25 in. into pneumatic pressures over a range of 5 to 30 psi. A typical application, cited by the manufacturer, is in recording the expansion of turbine rotors relative to the turbine casing.

Pipe Threader Is Self Oiling

No. 3820—Threadwell Tap and Die Co., Greenfield, Mass., has announced an improved design of pipe threading tool.



A full day's supply of oil is carried in the handle and the dies may be oiled while in use by pressing the plunger at the end of the handle. Another design advantage is said to be the location of the dies in direct line with the handle for easier operation without the possibility of twisting action, for true starting, smoother cutting, longer die life, and threading of short, close coupled nipples.

The unit is equipped with specially heat treated tool steel dies, designed with radial clearance for smooth operation. The die heads may be changed by pulling the knob on the ratchet pawl, and die segments are replaceable.

THE AIR YOU BREATHE SHOULD BE AS PURE AS THE WATER YOU DRINK

Exclusive ILG self-cooled motor

ILG VENTILATION

The match flame demonstrates how this patented ILG Motor *cools itself* with *outside air!* It's engineered to operate at *peak efficiency* in the contaminated air stream of an exhaust fan.

When fan is operating, clean, cool, fresh air is drawn through vent pipe from *outside*—circulated through motor, then exhausted from front of motor. Motor stays clean, cools itself—no foul air reaches it to interrupt service, shorten its life. It's tested. It's proved. It makes sense. Get complete details from your nearby ILG Branch Office (consult classified directory) or send coupon for free copy of new ILG Condensed Catalog and Data Book.

FREE! 48-page booklet showing solutions to wide range of ventilating problems. Send coupon for No. 544.

ILG ELECTRIC VENTILATING CO.
2841 No. Crawford Avenue, Chicago 41, Ill.
Offices in more than 40 Principal Cities.

☐ Send free copy of new Condensed Catalog and Data Book

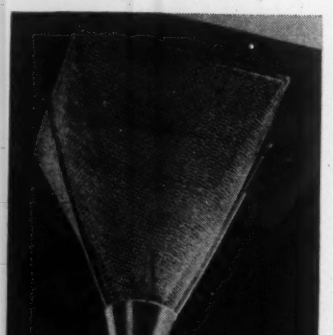
Firm Name_____

Individual_____ Title_____

Address_____ Zone_____

City_____ State_____

Grease Filter Has Cone Shaped Design



No. 3821** — The new "Filtair" grease filter, offered by Filtair Mfg. Co., 487 S. Van Ness Ave., San Francisco 3, Calif., is designed for installation in any range canopy and is said to fit any flue opening.

It has a special cone shaped design which is said to provide maximum exhaust efficiency and to trap the grease before entering the flue. The trapped grease is caught by the filter and drains into a detachable cup, according to the company.

The unit, manufactured of steel and treated with an acid and rust resistant coating, can be removed and is readily cleaned.

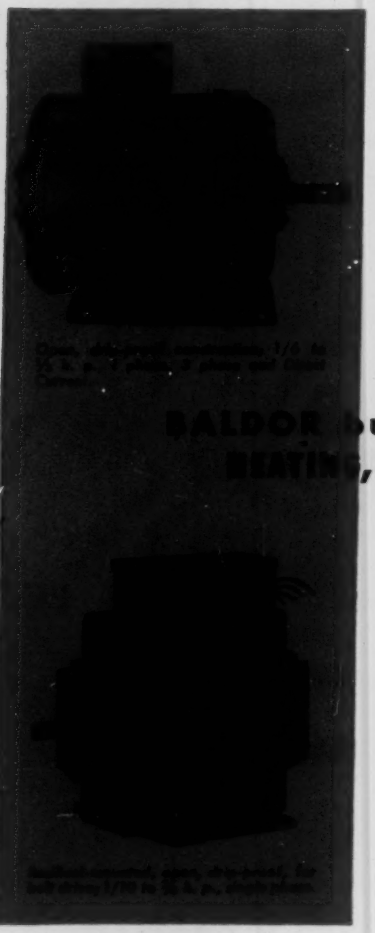
Equipment Shorts

A 40 min, 16 mm movie, Quality Control—From Ore to Finished Product, is available from Wolverine Tube, Div. of Calumet and Hecla Consolidated Copper Co., 1411 Central Ave., Detroit 9, Mich. Designed for professional, engineering, and business groups, the film is in color and follows copper ore from the company's mines through its fabrication as seamless, nonferrous tubing and on to typical end applications.

Redmond Co., Inc., Owosso, Mich., manufacturer of fractional horsepower motors, has purchased the Holtzer-Cabot Div., First Industrial Corp, Boston, one of the oldest motor manufacturers. The division is now known as Holtzer-Cabot Div., Redmond Co., Inc.

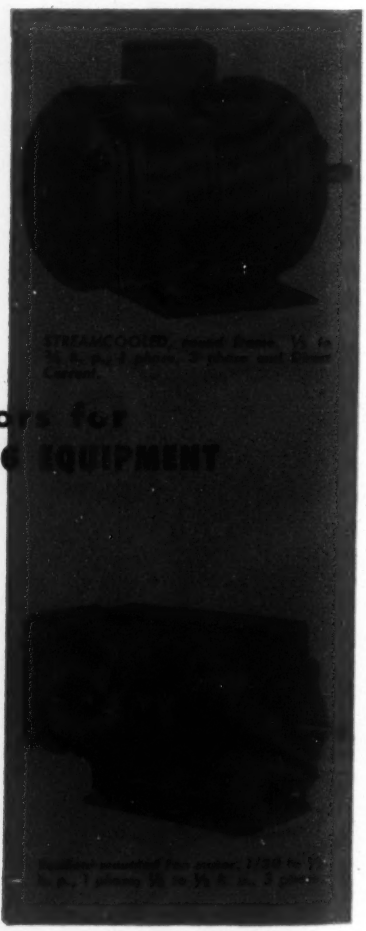
Kinetic Chemicals, Inc., Wilmington, Del., has announced the first price increase in the history of "Freon-12" refrigerant. Applicable to shipments in cylinder sizes up to and including 145 lb capacity, the increase is approximately 10 percent. These are the size cylinders on which the company pays the outbound freight on filled cylinders and inbound freight on empties. There is no price change for shipments in one ton containers which are sold f.o.b. the company's plants at Carney's Point, N. J., and East Chicago, Ind.

The second major 1948 reduction in prices of products has been announced by General Electric Co. The latest reduction, a flat 5 percent, applies to certain lines of apparatus department products including fractional horsepower motors, switchgear, conventional distribution transformers, feeder regulators, cutouts, and power capacitors. This is the company's second price reduction on fractional horsepower motors.



Arrows indicate forced air-movement over ENTIRE EXTERIOR of BALDOR STREAMCOOLED Motor.

Single Phase, ¾ to 7½ h. p.
3-Phase, 1 to 20 h. p.
Direct Current, 1 to 3 h. p.



BALDOR builds a Complete Line of Motors for HEATING, VENTILATING and AIR CONDITIONING EQUIPMENT

These BALDOR Motors have won national acceptance because of their cool-running, quiet, efficient operation. Many manufacturers in your industry have consistently used them for more than 25 years.

Baldor

ST. LOUIS, MO.
AND PRINCIPAL CITIES

BETTER MOTORS
FOR MORE THAN A QUARTER CENTURY

Young Radiator Co., Racine, Wis., manufacturer of heat transfer products for many industrial fields, including heating, cooling, and air conditioning, has purchased the Atlas Imperial Diesel Engine Co. plant and facilities at Mattoon, Ill. Plans are now being made to build additional facilities at Mattoon to accommodate increased production and expansion of the company's line of large "VAD" vertical air discharge cooling and condensing units, jacket water coolers, and other products.

The Industrial Div., York-Shipley, Inc., has adopted a new merchandising plan for its line of oil fired industrial equipment which includes "Steam-Pak" generators and rotary burners. Under the new plan, in line with the industry's program for cooperating with the oil industry, the availability of fuel oil will be taken into consideration at the time the company's equipment is sold.

Acro Welder Mfg. Co., Milwaukee, maker of spot, seam, projection, and portable gun resistance welding machines and brazing machines, has been acquired by a group headed by J. C. Wilson, Jr. The new organization plans to expand engineering and production facilities, make design changes, supplement the line, and set up a nationwide distribution.

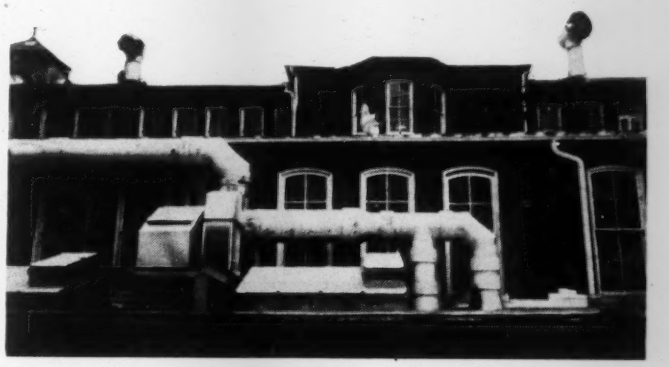
Charles Davies, New York industrial designer, has been retained by United States Air Conditioning Corp., Minneapolis, to develop and style a complete line of room coolers, store coolers, unit heaters, and air conditioning equipment.

According to Cochrane Corp., Philadelphia, experiments conducted over the past 10 years using high pressure air supplies for blast furnaces are providing a new application for its "Multiport" valves. Because uniformity of pressure is necessary to maintain velocity, the blast furnace air line is protected by a special 24 in. relief valve fitted with a hydraulic cylinder and special control.

The high pressure development work, done by Republic Steel Corp., indicates that pig iron manufacturing costs are cut by more than a dollar per ton, coke consumption is reduced 12 percent, and furnace capacity is increased 20 percent with a simultaneous reduction of dust and improved pig iron quality.

Net sales for 1947 of the Anemostat Corp. of America have been reported as $3,391,401, an increase of 52 percent over 1946. Net income for the year was $140,134 compared with 38,093 in 1946, and current assets of the company amounted to $344,202, an increase of 71 percent over the previous year. The backlog of unfilled orders at the end of 1947 totaled $1,300,000.

The Schaible Co., Cincinnati, manufacturer of plumbing fixtures and valves, is individually packaging its products so that they are protected and labeled. An "Eye-Tractive" merchandising service is the objective.



Here's a practical solution to many tough VENTING PROBLEMS

● Plant engineers in many industries are finding the answer to tough venting problems—and high venting costs—in Transite Industrial Vent Pipe.

EASILY WORKED: Transite can be cut and drilled on the job.

The reason: this asbestos-cement product is highly resistant to many corrosive fumes, vapors, dusts and gases. Its ability to stand up under corrosive conditions cuts frequency of replacements, results in important economies in plant maintenance.

In addition, Transite Industrial Vent Pipe has a smooth inner surface that assures minimum frictional resistance—means economical operation.

This pipe has many other practical advantages. Relatively light in weight, it is easily installed. It can be cut and drilled on the job. Rustproof, it needs no painting whether used indoors or out.

ADAPTABLE: A complete line of Transite fittings meets a wide range of job requirements.

Transite Industrial Vent Pipe is made in a range of sizes up to 36" in diameter and is readily adaptable for use as vents, ducts and stacks. A full line of Transite fittings provides a venting system which is corrosion resistant throughout.

For further information write Johns-Manville, Box 290, New York 16, N. Y. Ask for Data Sheet Series DS-336.

JOHNS MANVILLE JM PRODUCTS

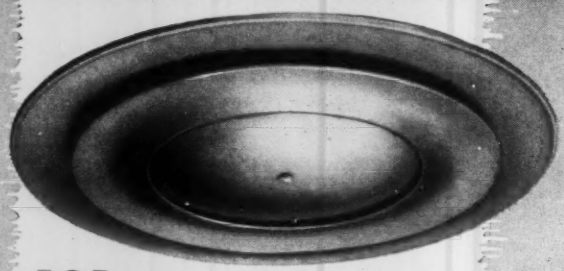
Johns-Manville TRANSITE Industrial Vent PIPE

BARBER COLMAN

Engineered Air Distribution

venturi-flo

CEILING OUTLETS

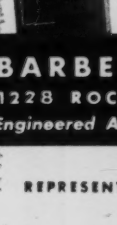


FOR...
QUIET OPERATION *and*
HIGH DIFFUSION EFFICIENCY

VENTURI-FLO Ceiling Outlets of the recessed type, illustrated above, are ideal for those applications where space requirements are limited. They present a pleasing appearance and allow maximum flexibility for architectural design and planning. Fittings are available for attaching any standard lighting fixture to the unit. VENTURI-FLO Outlets can also be furnished as combination supply and exhaust units or with adjustable volume control dampers.

THE VENTURI PRINCIPLE

The VENTURI-FLO air outlet has flow characteristics similar to those of the well-known fluid measuring device — the Venturi meter. The relationship between the neck area of the unit proper and the venturi throat area is so proportioned as to create a slight back pressure in the neck at all times, thereby automatically assuring uniform distribution around the entire periphery of the unit.



Write today for Bulletin F1497-3, giving full information on the various types of VENTURI-FLO units and their applications.

BARBER-COLMAN COMPANY
1228 ROCK STREET • ROCKFORD, ILLINOIS
Engineered Air Distribution with Guaranteed Performance

REPRESENTATIVES IN ALL PRINCIPAL CITIES

Equipment Shorts (Cont.)

Recently more than 400 sales and service executives from 45 sales districts in this country and 14 foreign countries were given an advance showing of new appliance and commercial and air conditioning product lines offered by Frigidaire Div., General Motors Corp.

Raytheon Mfg. Co., Waltham, Mass. has brought out a miniature of its electronic air cleaner that visibly removes tobacco smoke from the air. Called the Smoke Demonstrator, it is used by company sales agents and is available to dealers and distributors.

Builders Iron Foundry recently honored 95 employees at its fourth service award dinner held in Providence, R. I. Associated companies of the firm, also represented at the dinner, are Builders-Providence, Inc., Omega Machine Co., and % Proportioneers, Inc. %.

Pines Engineering Co., Aurora, Ill., has developed a high production, manually operated, bench type tube and rod end finishing machine now being offered to industrial manufacturers. The machine design is said to embody a new type mechanical chuck and chuck closing mechanism that holds any length tube, pipe, or rod up to 2 in. in diameter. The advance machine design and simplicity of operation are said to make it well adapted for use in those plants fabricating tubular stock and parts.

The pump division of Byron Jackson Co., Los Angeles, recently announced a new merchandising plan for its line of "Bilt-On" pumps. Units now feature interchangeability of basic parts. With eight cases, eight motors, nine impellers and a stock of small parts it is now possible to assemble 322 pump combinations that will handle capacities from 10 to 600 gpm at heads up to 340 ft.

Preferred Utilities Mfg. Corp. has built a new modern brick and glass walled factory at Danbury, Conn., where, under one roof, the company is concentrating its manufacturing operations. These include the manufacture of oil burning equipment and packaged steam generators.

L. J. Mueller Furnace Co., Milwaukee, has announced a new advertising and sales promotional policy in the form of permanent leatherette sales binders which are available to all company accounts. The binders are divided into three groups: prices, sales promotion, and erecting and adjusting. In addition, each binder is subdivided into sections by company products. To prevent loose leaf pages tearing out, 23 hole punchings are used.

Devoted exclusively to the fabrication of panel boards for automatic combustion control and instruments and controllers used in process plants, a new manufacturing building was recently dedicated by the Hays Corp. in ceremonies at the Michigan City, Ind., plant.

EXECUTIVE CHANGES

The stockholders of C. A. Dunham Co., Chicago manufacturer of heating specialties, have elected the following directors for the ensuing year: L. P. Dwyer, president, Dwyer Products Co., Michigan City, Ind.; Edward G. Bremner, president, Bremner Bros., Chicago; H. H. Wright, Kansas City, Mo.; F. E. Schmidt; and H. S. Marshall. The officers elected at a recent director's meeting include H. S. Marshall, president, F. E. Schmidt, vice president and treasurer, L. D. Mandell, vice president, and L. C. Murtaugh, secretary (counsel for the company).

The appointment of Walter G. Schlichting as sales manager of the heating, cooling, and air conditioning division, Young Radiator Co., Racine, Wis., has recently been announced. He is a graduate of the University of Illinois, has been active in the sales and engineering fields, and is a registered professional engineer in the state of Michigan, as well as a past president of the Western Michigan Chapter of the American Society of Heating and Ventilating Engineers.

Wilson & Co., Inc., Chicago manufacturer of hair filters, has appointed Robert M. Seepe as manager of hair filter sales. Mr. Seepe, who joined the company in 1936, received his B.S. degree in industrial administration from the University of Illinois and his M.S. degree in distribution and statistics from Northwestern University.

Walter Geist has been elected to his seventh term as president of Allis-Chalmers Mfg. Co., Milwaukee, and all directors and officers were re-elected at a recent annual meeting of the firm's stockholders and board of directors.

Minneapolis-Honeywell Regulator Co. has named Walter J. Baak, formerly Moduflow sales manager of the midwestern region, as sales manager of the wholesale division. G. M. Kingsland, who has been heading sales activities of the company's control devices and specialties departments, is taking over new duties in the heating controls division. He will head up sales activities of the stoker controls division.

Howard A. Turner is now manager of the Merchandised Products Div., Herman Nelson Corp., Moline, Ill., manufacturer of heating and ventilating products. He will coordinate the activities of all departments to further the development and marketing of unit heaters, propeller fans, and unit blowers.

A number of promotions within the Crane Co., Chicago manufacturer of valves and fittings, includes the appointment of L. W. Moore as director of purchases. C. T. Pollock takes over Mr. Moore's former position as general manager of sales and branch houses, and W. A. Burbine is now central district manager.

BARBER COLMAN

New Designs in Controls...

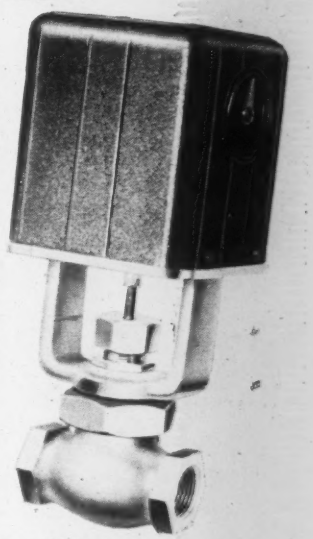
ROOM THERMOSTATS

The new Room Thermostat is designed for pleasing proportions, smaller size, and unobtrusive appearance. Redesign of the operating elements, detents, adjusting mechanism, and contacts produces a more accurate, more sensitive, more durable control instrument. New cases also appear on the Microtherms, with corresponding improvements.

Shown here is the new Barber-Colman Room Thermostat. Case dimensions are 2" wide, 4" high, 1½" deep.

MOTOR-OPERATED VALVES

Complete new design of the operating mechanism and housing is featured in the most popular sizes of Motor-Operated Valves. The cover is now metal, with a durable black crinkle finish. An indicating pointer on the outside of the case shows at a glance whether the valve is open or closed. Various carefully-engineered changes in the motor, reduction gear train, switch contacts, and other components combine to produce better motor-operated valves.



New Barber-Colman Motor-Operated Valve. The new design results in a better-looking, smaller, more compact unit.

WRITE FOR NEW CATALOG...

All of the numerous new ideas and improvements incorporated in Barber-Colman Automatic Controls for Heating and Air Conditioning are covered in a new Catalog. Write today for your copy, or ask your Barber-Colman representative.

BARBER-COLMAN COMPANY

1228 ROCK ST. • ROCKFORD, ILLINOIS

Automatic Controls for Heating and Air Conditioning

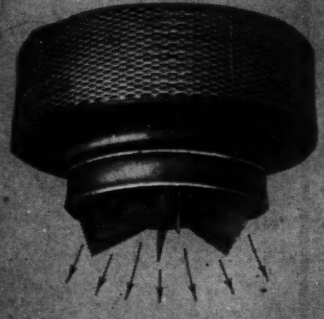
REPRESENTATIVES IN ALL PRINCIPAL CITIES

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES

All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p.s.i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

Executive Changes (Cont.)

J. J. Stephens, vice president, treasurer, and general manager of Strong, Carlisle & Hammond Co. since 1940, has been elected president and was re-elected treasurer. The firm manufactures a line of steam specialties and alloy steel screws. He succeeds G. J. Zimmerman who retired last December.

Cecil W. Farrar has been named director of sales promotion for Richmond Radiator Co., New York City. C. J. Vernay succeeds him as sales manager of the plumbing fixture division.

Allen-Bradley Co., Milwaukee, has appointed L. C. (Les) Watson sales manager of distributor sales. He is a member of the National Federation of Sales Executives, a member of the NEMA industrial control section, and is a registered professional engineer in Massachusetts.

John Menz, former sheet products manager, has been named assistant general sales manager in charge of sales promotion for Kaiser Aluminum, according to an announcement from Permanente Metals Corp., Oakland, Calif. Mr. Menz studied at the University of Illinois, Purdue University, and Washington University in St. Louis, where he received his degree in commerce and finance. He has been with the Kaiser organization two years. Marvin Lee, formerly production manager at the Trentwood rolling mills in Spokane, assumes the duties of sheet products manager for the sales department.

George Schaefer is now works manager for Henry Valve Co., Chicago. He has been with the company for eight years and has specialized largely in problems of production.

According to a recent announcement from Allegheny Ludlum Steel Corp., W. F. Detwiler, chairman of the board of directors for the past 10 years, has been named honorary chairman. Also announced is the election of Lester H. Bittner, director of purchases, to the newly created position of vice president in charge of purchases.

Paul V. Roth, shop engineer since 1919 of Leeds & Northrup Co., has retired after nearly 46 years of service. Another retirement, recently announced, is that of Felix Wunsch, a veteran of the company's engineering staff and inventor of numerous circuits widely used in electrical measuring instruments. Mr. Wunsch had been with the company nearly 43 years and has had patents issued on 12 designs.

David Levinger has replaced the late Dr. Frank R. Lillie as a director of the Crane Co., Chicago. He is a director and vice president of Western Electric Co. and works manager of its Hawthorne plant. H. H. Bunchman has been elected treasurer of the company to fill the vacancy left by the retirement of Walter Evensen after

Air-foil

AIR DIFFUSING OUTLETS

TMC introduces the newest and finest in air diffusing outlets—the TMC Airfoil Grille featuring the new TMC Airfoil Louvre. Completely new—completely different—the TMC Airfoil Grille represents the greatest advance in air diffusion design in 20 years.

• The Airfoil Louvre is shaped like the wing of an airplane—handles more air at higher velocity. • Mullions and butted construction are eliminated from all TMC Grilles. • TMC Grilles are custom built to meet individual requirements. Write today for complete information, including prices and deliveries. Address Dept. HP748.

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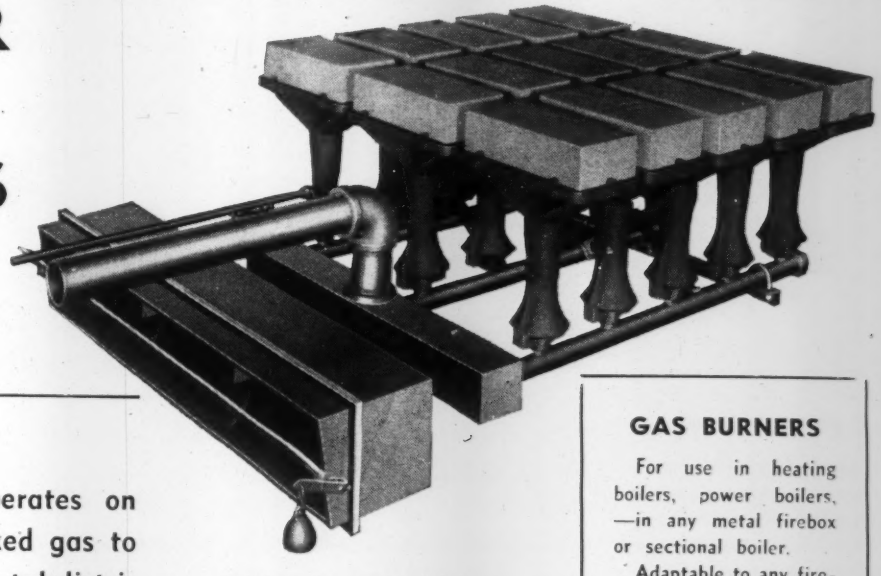
TITUS MANUFACTURING CORP. • WATERLOO, IOWA

WEBSTER

Series F600

GAS BURNERS

50,000 to
10,000,000 Btu.



The Series F600 Burner operates on straight natural gas and mixed gas to 800 Btu. Gives perfect horizontal distribution. Fully automatic controls—that operate properly—can be easily applied.

Write for new illustrated Catalog of Webster Burners and Controls.

GAS BURNERS

For use in heating boilers, power boilers, —in any metal firebox or sectional boiler.

Adaptable to any firebox shape or size.

Handles various gas pressures and effects low draft loss.

THE WEBSTER ENGINEERING CO.

— DIVISION OF —

Surface Combustion Corporation . . . . . Toledo, Ohio
TULSA **OKLAHOMA**

Executive Changes (Cont.)

more than 50 years of service. Other new officers elected at the board meeting were J. W. Hederick, assistant secretary, and H. A. Tacon, assistant treasurer.

R. V. Clark, formerly district manager of the company's Dayton office, has been named manager of heating controls sales for Penn Electric Switch Co., Goshen, Ind. He has been with the company for 20 years and possesses a wide and varied experience in the application of controls for automatic heating.

C. L. Hewitt, Jr., general sales manager, L. J. Mueller Furnace Co., Milwaukee, has been elected chairman of the boiler division of the Gas Appliance Manufacturers Association. Mr. Hewitt, whose term of office is one year, will be responsible for coordinating activities of the gas boiler manufacturer members.

E. H. Weihe, who has been with Owens-Corning Fiberglas Corp. and predecessor companies for over 30 years, has been named assistant treasurer. He has been credit manager of the company since 1942.

E. W. Becker is now regional manager of the unit air conditioner division of Fedders-Quigan Corp., Buffalo. He is covering the eastern seaboard territory with resident headquarters in Freeport, N. Y.

Robert West is the new regional sales director for the midwestern area of Typhoon Air Conditioning Co., Inc., Brooklyn, N. Y. He is supervising representatives in Illinois, Missouri, Kansas, Nebraska, Iowa, Wisconsin and Minnesota.

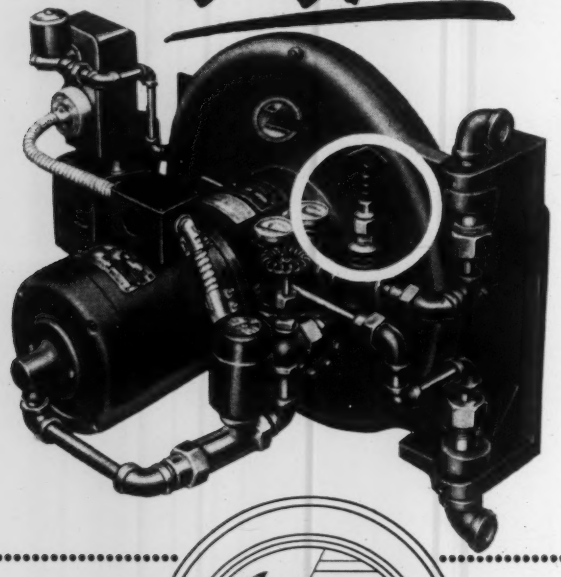
The National Radiator Co., Johnstown, Pa., has elected J. C. Barnes as vice president in charge of sales. He is a former sales manager of the company's Washington and Philadelphia branch offices and has been associated with the firm since 1940. He attended the University of Maryland and John Hopkins University.

At a recent membership meeting of the Midwest Stoker Association, F. H. Herndon was elected secretary-treasurer of the organization, succeeding J. W. Akins, Jr. Mr. Herndon has recently formed his own distributing firm.

Harrington & King Perforating Co., Chicago, has announced the retirement of J. M. Fuller as president after 62 years of service. F. P. Hutchinson is the new president. J. E. Fuller has been elected vice president and treasurer and S. Harrington, Jr., is secretary.

R. B. Lloyd, who joined Rheem Mfg. Co. (maker of water heaters, soft water appliances, heating equipment and steel shipping containers) in 1944, is now manager of plants. He has been in charge of various company plants during the last few years.

BURN *Any Type Oil* IN THE ACE UNIFLOW BURNER



—Patented Uniflow Oil Valve Assures Uniform Flow and Flame

Regardless of changes in oil temperature or viscosity, the Ace Uniflow Valve permits a constant uniform flow and flame as desired. Heavy residual fuel oils may be burned efficiently under all operating conditions. No matter whether the oil is light or heavy—kerosene or bunker "C"—whether the temperature is 32° F or 180° F, the correct proportioning never varies.

This is just one big feature of the popular Ace Uniflow Oil Burner, custom-made for particular heating requirements.

Send for complete details today.

Capacity Ranges

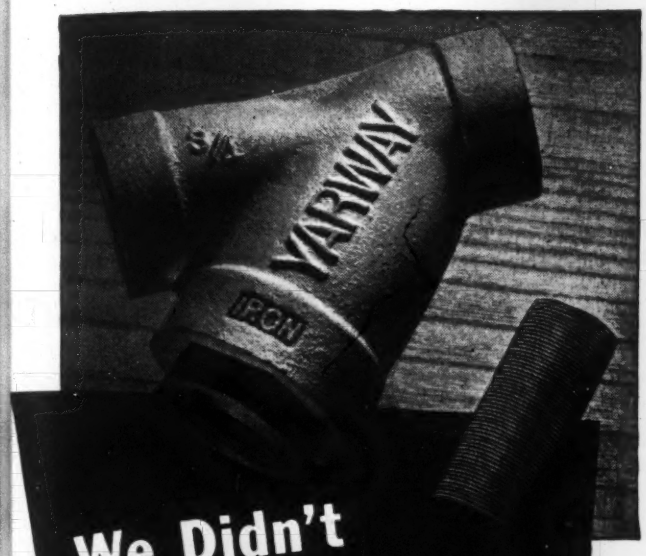
	GALLONS PER HOUR	BOILER H.P.	SQUARE FEET STEAM RAD.	SQUARE FEET WATER RAD.
MINIMUM	4	12	1,600	2,600
MAXIMUM	165	500	64,000	104,000

Ace UNIFLOW OIL BURNERS

ACE ENGINEERING CO.

1435 W. 15th Street • Chicago, Illinois

Custom Engineered Oil Burning Systems Since 1931



We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

Examine its *high grade Monel woven wire screen* that stops dirt —lets condensate or other fluids flow freely.

Notice the removable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Cadmium plated for protection against corrosion and for better appearance.

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-201

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Plan HEAT TRANSFER with REMPE

Our Long Experience at Your Service

HEAT TRANSFER EQUIPMENT
REMPE CO.
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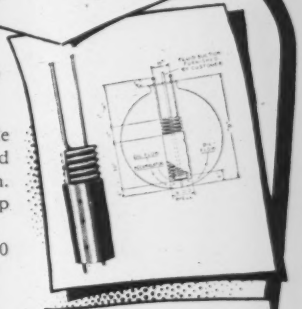
ENGINEERED and BUILT for EFFICIENT DEPENDABLE PERFORMANCE

The Rempe "HOT SPOT" Fuel Oil Preheater

This efficient heater is available in 16" or 14" diameter size, and for use with hot water or steam. For use in oil storage tanks up to 12 feet diameter.
List Price $87.50

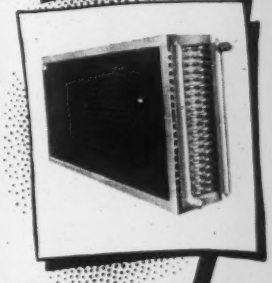
Write for full descriptive data.



Rempe Fin Coils for Heating or Cooling Application

Fin Coils designed by Rempe always carry their heat load with ease because they are never overrated. Made for any refrigerant, cold water, hot water or steam. For any temperature between minus 60° to plus 350° F.

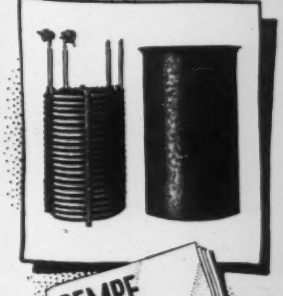
Send us your special problems.



Rempe Pipe Coils for all Process Work

Rempe has been making pipe coils for 57 years. Any diameter or any length, to your specifications or our design. Can be supplied in any Steel, Alloy, Stainless Steel, Copper or Aluminum.

Send full details for engineering assistance or quotation.



The Rempe Engineering Data Book

Most essential to the Engineers Library. A request on your letterhead will bring this Complete Engineering Data Book for design of Pipe Coils or Fin Coils.

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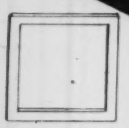
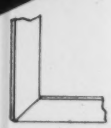
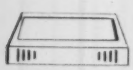
These EXTRA Aircor Features Mean EXTRA Filtering Efficiency



GALVANIZED STEEL FRAMES



FULL BRONZE WELDED CORNERS



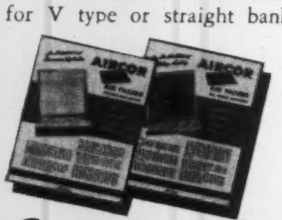
DRAIN SLOTS FOR QUICKER, EASIER CLEANING

EXPANDED METAL FACE PLATE

Media of Aircor Air Filters is viscous type, permanent and cleanable. Constructed of multiple layers of galvanized wire mesh, media is designed to give maximum efficiency plus large dust holding capacity at low resistance. Expanded metal face plate acts as lint arrestor — distributes air evenly over entire filtering area, and aids in easier cleaning and servicing.

Available in standard 1" and 2" thickness, or for industrial and special applications in 2" to 4" thickness. Holding frames for all type filters for V type or straight banks.

SEND FOR THESE BULLETINS



Air Filter Corporation

108-F North Water St., Milwaukee 2, Wis.

Canadian Representative

DOUGLAS ENGINEERING CO., LTD. MONTREAL

NEW BOOKS & REPORTS

More Engineering Data Included in Newly Revised Fan Handbook

Air conditioning and ventilation engineers have long regarded the handbook, Fan Engineering, as "a bible of the industry." Originally conceived and edited in 1914 by Dr. W. H. Carrier, new editions appeared in 1925, 1933, and 1938. The fifth edition, edited by R. D. Madison and now off the press, again deals with air and its movement and distribution in air conditioning, combustion, conveying, and other applications employing fans.

Although greater coverage of air conditioning equipment has been given in this edition, which has been rewritten and reset, it has been briefed to give greater space to engineering data. Many of the tables have been revised to keep abreast of the latest available information. A revised and more complete index of charts and tables is given and, preceding the section on examples, there is a short summary of the more important examples distributed throughout the book.

Part 1 on the physics of air includes data on the properties of air and air-vapor mixtures, fluid flow, and air distribution. Part 2 covers centrifugal and axial flow fans, the laws of fan performance, fan testing, sound, fan dynamics, fan power equipment, and the jet pump. Part 3 deals with fan applications in heating, ventilation, humidifying and dehumidifying, cooling and refrigeration, drying, combustion and mechanical draft, air cleaning, and exhausting and conveying. In Part 4 fans and air conditioning equipment, offered by Buffalo Forge Co., are covered.

This bound volume contains 808 pp. (4½ x 6½ in.) and is published by Buffalo Forge Co., Buffalo, N. Y. The price is $6.00 per copy.

Offers Helpful Data for Design and Purchase of Air Conditioned Crane Cabs

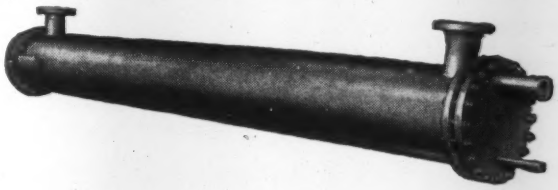
The increasing use of floor area for furnaces, soaking pits, kilns, and ball mills in industrial plants has increased the problems, in certain heavy industries, of heat, dust, and smoke. Air conditioning is proving to be a successful method of dealing with one of the most important difficulties—maintaining good working conditions in crane cabs.

A pamphlet, Air Conditioned Crane Cabs, by B. R. Small, Aluminum Co. of America, will undoubtedly be of considerable interest and will provide useful data for anyone involved in this work, either from the standpoint of design or purchase. The author, a member of the preventive engineering committee of the Industrial Hygiene Foundation, outlines practical measures which have been used in industry for the removal of heat, dust, fumes, and gases in crane cabs.

In discussing the required degree of cooling, Mr. Small says that either a design temperature differential of from 78 F in cool weather to 83 F in hot weather or a fixed cab temperature of approximately 81 F may be used. He believes the sliding temperature differential basis to be more practical as it permits a more economical selection in the size of the refrigeration unit. He also states that mechanical refrigeration, as distinct

ACME PRODUCTS

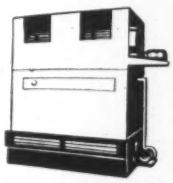
Continuously serving
THE REFRIGERATION AND
AIR CONDITIONING
INDUSTRY
Since 1919



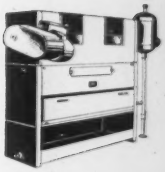
Representatives in principal cities

Dry-Ex Water Chillers

For chilling water in large volume, Acme DRY-EX Water Chillers assure efficient performance. For air conditioning systems and for industrial uses, they have long enjoyed high nation-wide acceptance. They comply with ASME Code. Write for complete descriptive data.



Evaporative Condensers



BLO-COLD Industrial Unit Coolers

ACME INDUSTRIES, INC.
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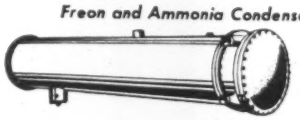
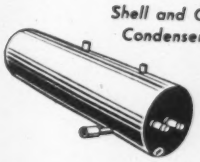
Freon and Ammonia Condensers



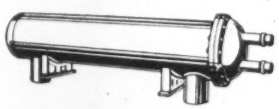
Oil Separators

Shell and Coil Condensers



Pipe Coils

Heat Exchangers



Liquid Receivers

MARLEY "Packaged Unit" TOWERS

For limited capacity service Marley Aquatowers and Series 100 Atmospheric Towers have earned highest rating in hundreds of installations the country over.

AQUATOWERS for Indoor and Outdoor Installation. These complete units are quickly and easily installed by making a few simple connections. Aquatowers are available in two general styles and in seven sizes, for three to fifty tons of refrigeration.

Series 100 Atmospheric Towers for Outdoor Installation. Designed for maximum economy of installation and operation, these towers are prefabricated for ease of erection. Quality materials assure years of uninterrupted service.

Marley Way . . .. the Perfect Spray

Marley Patented Spray Nozzles for cooling towers, processing and air washing provide maximum distribution at lowest pressure. Absolute minimum of maintenance is necessary.

MARLEY COOLING TOWERS

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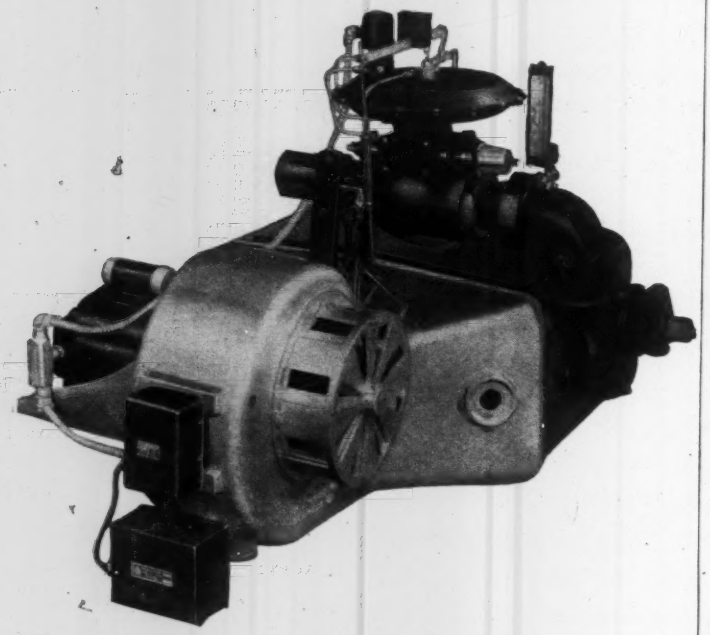
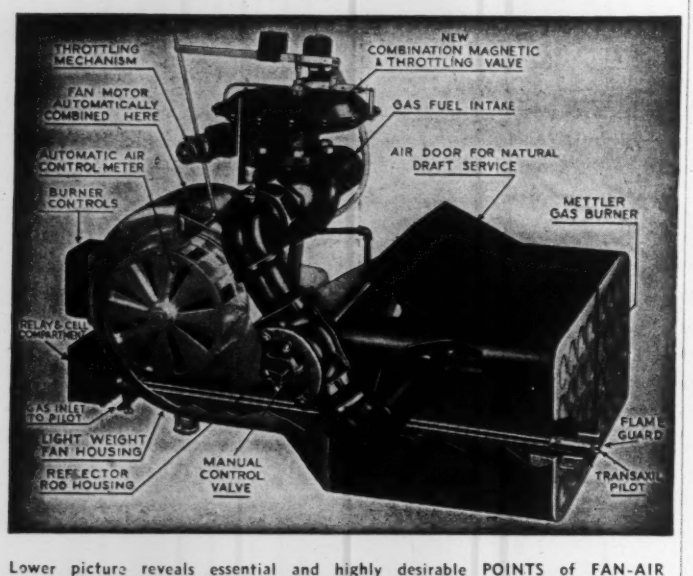
ENTRAINED COMBUSTION
EXPERTO CREDE

The Mettler "FAN-AIR" Gas Burner

LATEST MODEL FEATURES NEW AUTOMATIC SAFETY PILOT and TRIPLE CONTROLS



HERE IS A "FRONT VIEW" OF FAN-AIR GAS BURNERS (COMPACT AND SIMPLE)



Lower picture reveals essential and highly desirable POINTS of FAN-AIR MECHANICAL DRAFT GAS BURNERS. Not just a gas burner but a COMPLETE AND FULLY AUTOMATIC BURNER SYSTEM, factory tested and ready for application when received. It comes to you complete as pictured with simple, dependable, automatic controls. No other burner so easy to install. Why be satisfied with less—when all these tangible advantages are so readily available. SIZES 5 to 400 HP.

LEE B. METTLER CO.

406 South Main Street

LOS ANGELES 13 CALIFORNIA

from water spray cooling, is required for heavy duty cabs where ambient temperatures are 125 F or higher, but he points out that despite disadvantages as compared with mechanical refrigeration, evaporative cooling is advantageous for some applications in northern states where temperatures at the crane level do not exceed 100 to 110 F. The advantages, of course, consist of relatively low first cost, simplified maintenance, and effectiveness in air purification without auxiliary means.

According to the author, "Freon-12" was used in cab air conditioning units until 1945 when "Freon-114" became popular for this application because it will condense with ease when high temperature air is used as the coolant and will still remain at relatively low pressure.

In discussing virtually all phases of conditioning crane cabs, Mr. Small talks about methods and equipment which have actually been used, citing advantages and disadvantages of each. In addition, he helpfully gives approximate costs (based on 1946 prices) of the various equipment and material items and also indicates to what extent crane cabs will be out of service during the various installation steps.

An appendix by C. A. Stevenson outlines the experience of a large nonferrous metallurgical plant in the development of conditioned crane cabs.

This 24 page, 6 x 9 in, paper covered pamphlet is identified as Preventive Engineering Series Bulletin No. 4 and is available from the Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13, Pa., for 50 cents per copy —while the limited supply lasts.

Steel Pipe Specifications Cover Normal, High Temperature Service

ASTM Specifications for Steel Piping Materials, issued by the American Society for Testing Materials, gives in the latest form as of December 1947 all of the specifications covering steel piping materials, including pipe, tubes, castings, bolting, etc.

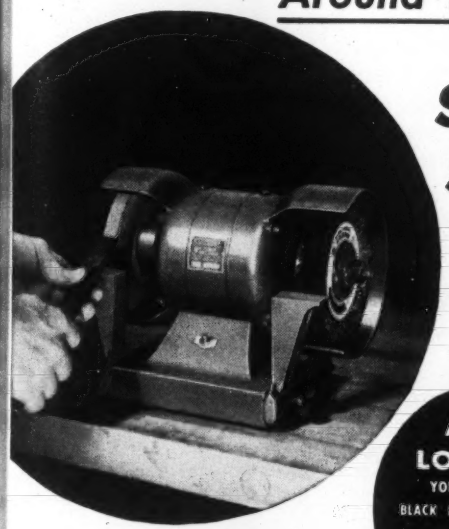
Specifications cover pipe for service at normal and elevated temperatures, and several carry 1947 designations indicating that these were revised effective last year. In the field of tubing for boilers, and superheaters, there are 13 specifications covering seamless, welded and other types of tubes involving a wide range of chemical composition and properties. There are three specifications each for still tubes and for heat exchanger and condenser tubes. Five relate to castings for general application and high temperature service. Three standards pertain to forgings or rolled pipe flanges and one covers welded fittings. There are three relating to bolting, and the book includes a classification of grain size in steel, E-19, with its two charts.

Copies of this 315 page book, in heavy paper cover, can be obtained from ASTM headquarters, 1916 Race St., Philadelphia 3, Pa., for $3.00 per copy.

Text on Fine Particle Technology Is Important Reference Book

To offer a text which he hopes will be considered a standard reference in the field of fine particle technology is the stated objective of J. M. DallaValle in the second edition of his book, Micromeritics—the Technology of Fine Particles.

SPOT these $38 BENCH GRINDERS Around Your Shop



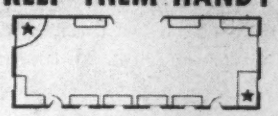
SAVE STEPS— SAVE TIME!

AT THIS LOW PRICE YOU CAN USE SEVERAL BLACK & DECKER 6" STANDARD BENCH GRINDERS

MANY PRACTICAL FEATURES!

- Constant speed Black & Decker 1/4 H.P. motor gives ample power for "run-of-shop" jobs—economical to run.
- Fully protected full-size ball bearings on rotor and wheel spindles.
- Easily adjusted tool rests.
- Base has 4 rubber feet for bench-work. Bolts to pedestal for spotting anywhere.

KEEP THEM HANDY



for Your Workers!

SPEED UP Grinding, Wire Brushing, Buffing!

Economical to buy—economical to operate—sure to increase your efficiency! That's why it pays to install Black & Decker 6" Standard Bench Grinders at handy spots in your shop. They keep tools sharp and clean; grind rings, pipe, braces, etc.; remove rust and prepare surfaces for painting. See your nearby B & D Distributor. Write for free catalog to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Maryland.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC TOOLS

Kerrect!

The dictionary says O.K. is probably derived from the Choctaw oke *meaning "yes" or "it is." But that ain't the way we heerd it. They say a fellow used O.K. as the abbreviation of "Oll Kerrect."*

While the "K" on our fittings stands for Kuhns, it could aptly stand for "Kerrect" . . . because that's what "K" Fittings are! They're precision-cast, precision-machined, precision-inspected.

Every "K" fitting is guaranteed to be correct in wall thickness, tapping, and for drilling—free from sand holes, cold checks, and other blemishes.

The "K" line of fittings that fit includes:

- Standard and Extra Heavy Cast-Iron Screwed Fittings
- Standard Flanged Fittings
- Standard and Extra Heavy Companion Flanges
- Drainage Fittings

THE KUHNS BROS. CO.

DAYTON 1, OHIO

K

Combined Sales Facilities at Malleable Iron Fittings Company, Branford, Conn., and Kuhns Bros. Co., Dayton, Ohio

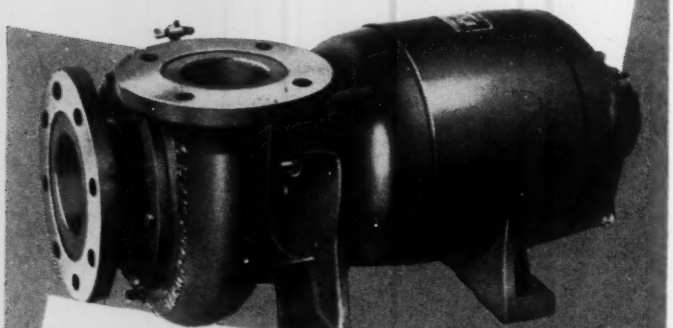
"K" PRECISION FITTINGS

NOTE: this message will interest plant and consulting engineers who know that an air-conditionig system is no better than the pumps employed!

where EFFICIENCY!... ECONOMY! ...and DEPENDABILITY!...count!

A WEINMAN PUMP IS THE HEART OF THE AIR-CONDITIONING SYSTEM!

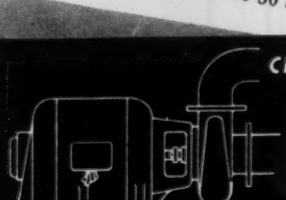
What greater proof of quality can any pump offer than its on-the-job performance record? . . . and the WEINMAN pump record for day in and day out *Dependability!* . . . *Efficiency!* . . . and *Economy!* . . . as the heart of countless air-conditioning systems, is a record to convince you that *Weinman Pumps Are "Right" For The Job* . . . made right by centrifugal specialists who know air-conditioning pump requirements.



WEINMAN TYPE "G" UNIPUMP

Especially adapted for circulation of chilled water or brine. Sizes to provide capacities of 10 G.P.M. to 1000 G.P.M., heads to 500 ft., and motor ratings ranging from ½ hp. to 30 hp.

CENTRIFUGAL SPECIALISTS



WEINMAN PUMP MFG. Company

COLUMBUS · 8 · OHIO

The book deals with particles ranging roughly from the larger colloid sizes to particles an inch in diameter. The work of many men in many fields is condensed and presented as a new science of particles. As such, the book offers valuable information to both technical and research men. A great deal of scattered information on the subject is collected and outlined in this book for easy reach, a justification for the book in itself.

Information on dynamics, sampling, size measurement, statistical analysis, adsorption, and diffusion of small particles can be found by the air conditioning man. The chapters on atmospheric and industrial dust and on particle removal from air will also be found interesting to many in the air conditioning field.

The book may find its place as a text for engineering courses, but it is more important as an excellent reference in the field of fine particle work, the chief objective of its author.

Published by Pitman Publishing Corp., 2 W. 45th St., New York City, this 555 page, 6 x 9 in. clothbound text is priced at $8.50—Reviewed by Lester T. Avery, president, and Jarl R. Swanson, Jr., Avery Engineering Co., Cleveland.

Gives Practical Methods for Bending Copper Pipe and Tubing

Whether you are interested in bending extremely small or large pipe and tubes of copper, brass, and related alloys, much useful information will be found in the Pipe and Tube Bending Handbook (third edition), published by the Copper and Brass Research Association.

Originally issued during the war, the booklet has been completely revised to include the latest data on the subject. Many of the leading types of hand benders and bending machines are discussed and, in most cases, illustrated. One section deals entirely with an analysis of the different basic bending methods and the principles involved in each.

Available from association headquarters, 420 Lexington Ave., New York City, the 48 page booklet measures 8½ x 11 in. and is paper covered.

Gives Capacities of Hand Fired Hot Water Supply Boilers

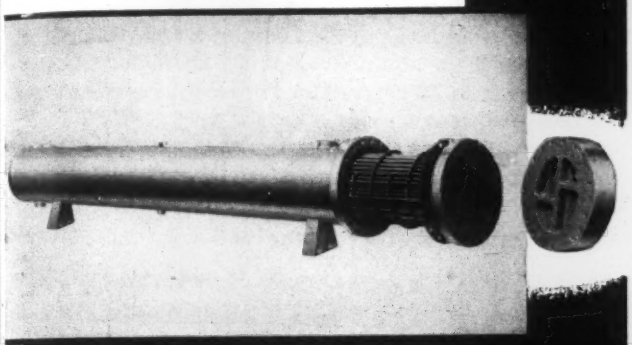
Commercial Standard CS145-47, Testing and Rating Hand Fired, Hot Water Supply Boilers, initiated by the Federal Housing Administration, is the result of several years development by the trade, with active participation by the Anthracite Institute and the Institute of Boiler and Radiator Manufacturers. It covers the testing and rating of all sizes of hand fired, solid fuel burning hot water supply boilers, except those of the magazine feed type and laundry type. Ratings are expressed in Btu per hour, and in gallons of water heated 100 F in 3 hr.

According to the National Bureau of Standards, information is given so that the consumer will know, prior to purchase, the maximum output and the capacity under specified test conditions. The standard may be used as a basis for purchasing and for eliminating confusion among buyers and sellers as to the significance of published ratings.

Copies are for sale by the Superintendent of Docu-

PATTERSON-KELLEY
Heat Exchangers
AND
Process Equipment

Heat-Transfer SPECIALISTS



Specializing IN REFRIGERANT COOLERS

The very essence of "air conditioning" is the controlled transfer of heat.

It was entirely logical, therefore, that Patterson-Kelley engineers, who have specialized for years in heat-transfer equipment, should turn their attention years ago to refrigerant coolers, condensers and other heat-transfer equipment needed in air conditioning and refrigeration systems.

Today, Patterson-Kelley Equipment, coolers for example, is considered by many to be the standard for such installations.

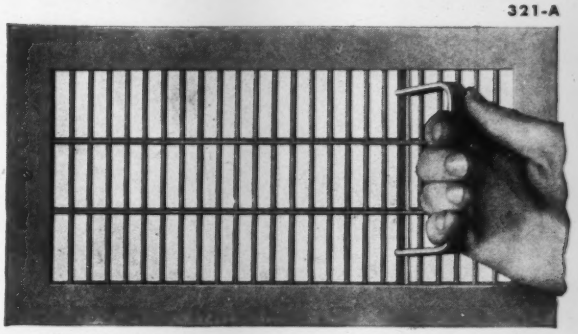
EST 1880
THE PATTERSON-KELLEY Company, Inc.
107 WARREN STREET, EAST STROUDSBURG, PA.
NEW YORK 17—101 Park Ave. PHILADELPHIA 3—1700 Walnut St.
CHICAGO 4—Railway Exch. Bldg. BOSTON 16—96-A Huntington Ave.
Representatives in Principal Cities

INDEPENDENT

"Fabrikated" WALL GRILLES for Commercial Installations

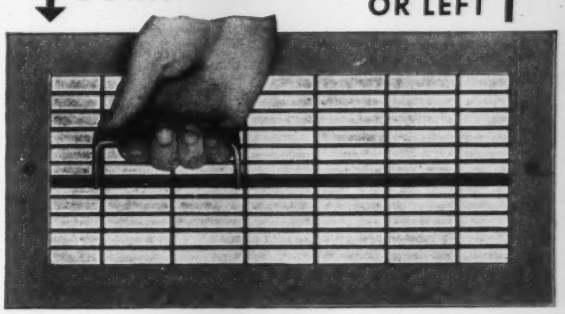
PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A



UP OR DOWN

RIGHT OR LEFT



311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

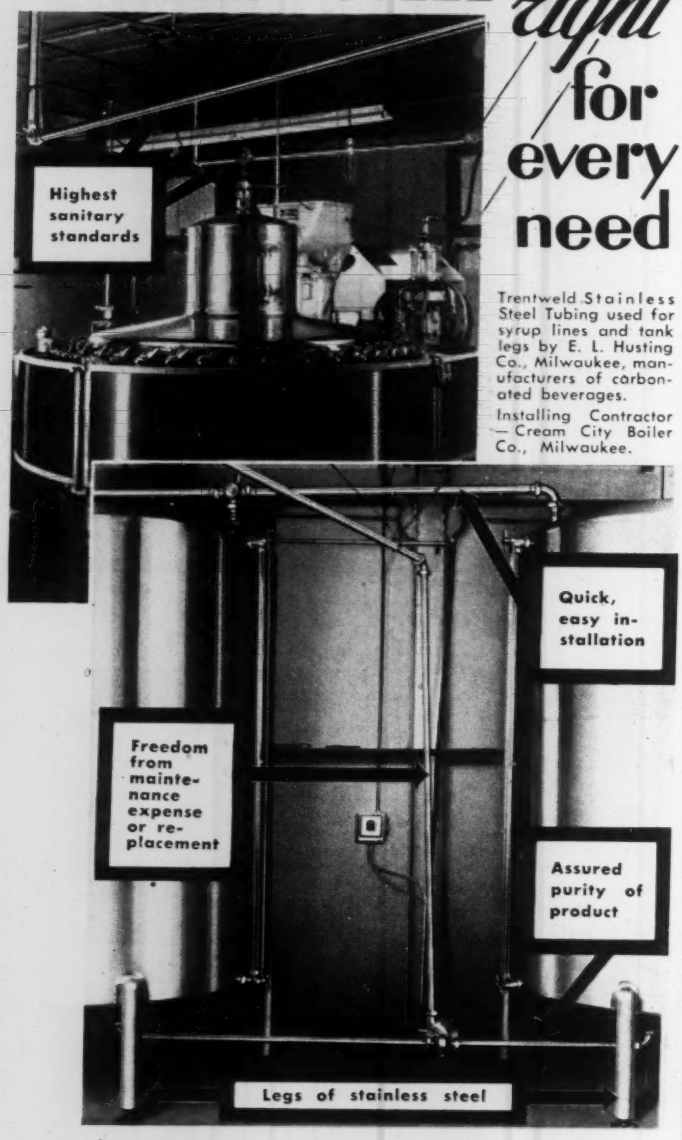
Write for new Catalog No. 48—gives schedule of sizes, details and prices.

Always Leading — Always Progressing

*Reg. U. S. Pat. Off.

THE INDEPENDENT REGISTER CO.
3747 E. 93rd STREET · CLEVELAND, OHIO

Flow lines of Trentweld STAINLESS STEEL right for every need


Highest sanitary standards
Quick, easy installation
Freedom from maintenance expense or replacement
Assured purity of product
Legs of stainless steel

Trentweld Stainless Steel Tubing used for syrup lines and tank legs by E. L. Husting Co., Milwaukee, manufacturers of carbonated beverages. Installing Contractor — Cream City Boiler Co., Milwaukee.

WHEREVER flow lines must carry corrosive substances in any form, the efficiency of Trentweld stainless steel tubing is all inclusive. Highly resistant to the action of acids or alkalines, this rugged thin-walled tubing is made to deliver substantial savings over the years to the installation owners in eliminating replacement costs and maintenance expense. Of interest, too, initially, is the fact that this light weight tubing, in diameters up to 30", is easy to handle under any condition. It saves manpower, makes installation work a smooth-running, time-saving job. Trent engineers are at your call at all times to give you whatever help or information you may require. Without obligation, write:

TRENTWELD STAINLESS STEEL TUBES

District Offices—New York, Chicago

TRENT TUBE MFG. CO.

430 Church St. East Troy, Wisconsin

ments, Government Printing Office, Washington 25, D. C., for 10 cents each. A discount of 25 percent will be allowed on orders for 100 or more copies.

ASA Publishes Price List of Standards

An up to date list of all national standards approved by the American Standards Association has been published and is now available.

The list includes national standards for such important problems as dimensions of machine tools and parts, rating and testing of electrical equipment, dimensions and identification of pipes and piping, building code requirements, industrial safety and health, together with definitions, abbreviations, and symbols used in technical literature.

The new price list makes available a complete set of all American Standards at $225.00 and a complete set of all American Safety Standards at $35.00. Quantity discounts range from 20 percent to 45 percent for quantities up to 1000 copies.

Copies of the list can be obtained from the association, 70 E. 45th St., New York 17, N. Y., at no charge.

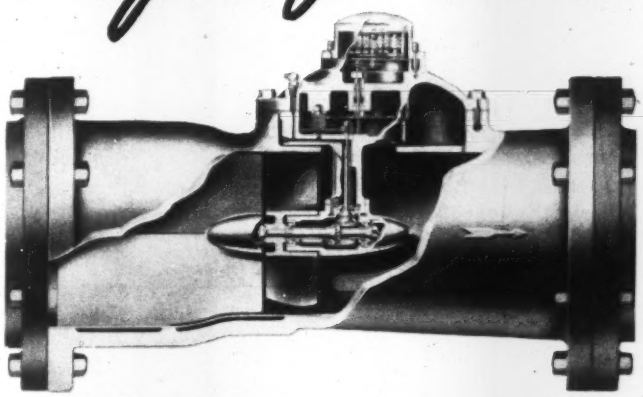
Other Books and Reports Received

Steam, Air, and Gas Power, by W. H. Severns, professor of mechanical engineering, University of Illinois, and H. E. Degler, technical director, Marley Co., and formerly professor of mechanical engineering, University of Texas. This fourth and revised edition contains basic information on power and heat engineering. New material on the gas turbine and other recent developments has been added and the material in the former editions has been revised and brought up to date. Priced at $4.75, this 509 page, clothbound book is published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City.

Scientific and Technical Abbreviations, Signs, and Symbols, by O. T. Zimmerman, professor of chemical engineering, University of New Hampshire, and Irvin Lavine, formerly professor of chemical engineering and head of the department, University of North Dakota. According to the publisher, Industrial Research Service, Masonic Bldg., Dover, N. H., this book contains thousands of abbreviations, signs, and symbols for all of the major scientific and technical fields. Standard symbols, both letter and graphical, of the American Standards Association are included. The clothbound text contains over 475 pages and is priced at $7.50.

Man-Weather-Sun, by W. F. Petersen, M.D.—published by Charles C. Thomas, 301-327 E. Lawrence Ave., Springfield, Ill. Contains 464 pages, 294 illustrations, and is priced at $10.00. Dr. Petersen presents a history of individual reaction to atmospheric environment. Through a detailed study of normal adult triplets he pictures the efforts of the human organism to maintain an unstable equilibrium in the atmosphere. Various mechanisms, from the biochemical to the mental, are studied to demonstrate the effect of climate on the human race, and from studies of appendicitis, epilepsy, scarlet fever, and cardiac disease the author concludes that man is dependent on his atmospheric surroundings.

Propeloflo METER

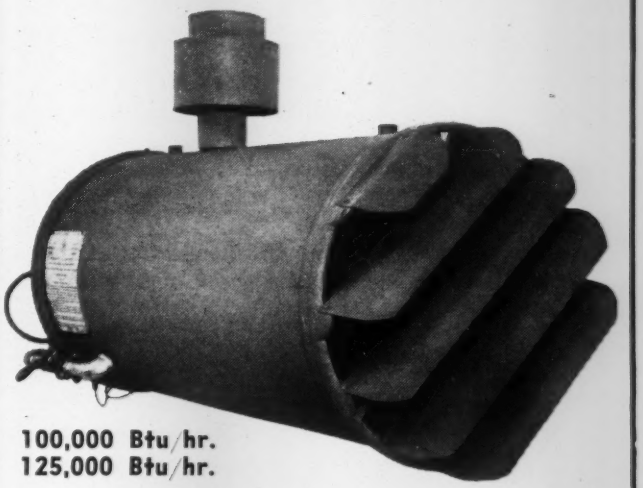


BUILDERS Propeloflo Meter takes the guesswork out of main line metering — keeps accurate count of WHERE water is going AND HOW MUCH. Widely accepted for its proven dependability, this Meter gives gallon-by-gallon information on actual flow conditions. The unit is totally self-contained and self-actuated; reads directly in gallons. It's easy to install, too — as easy as adding a new pipe section. BUILDERS streamline Venturi design gives accuracy within ±2% over a wide range and its low pressure loss minimizes pumping costs. For Bulletin 350A, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 41 Codding Street, Providence 1, R. I.

BUILDERS PRODUCTS

Venturi, Propeloflo and Orifice Meters • Type M, Flo-Watch and Flo-Gage Instruments • Shuntflo Steam Meters • Kennison Nozzles • Chronoflo Telemeters • Conveyoflo Meters

BUILDERS PROVIDENCE
Instruments



100,000 Btu/hr.
125,000 Btu/hr.

It's New!

It's Amazing!

This John Zink UNIT HEATER

This new and unique design in suspended space heaters features: More Head Room—Compact design—More Heat from gas burned, gas company test shows overall efficiency of 82%.

Where floor space is at a premium this turbine type unit has greater heating capacity. Controls are built-in. Unit is shipped completely assembled ready for installation. One unit will heat a 40′ x 80′ space. It is A. G. A. approved for liquefied petroleum gases, manufactured or natural gas.

- **Finished in Toast Tan Crinkle Enamel Baked On**
- **Adjustable Louvers**

— Write for Literature —

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MEETINGS & CONVENTIONS

The Third National Instrument Conference and Exhibit—sponsored by the Instrument Society of America, 1117 Wolfendale St., Pittsburgh 22, Pa. To be held September 13 to 17, Philadelphia Convention Hall.

American Gas Association, 420 Lexington Ave., New York City—1948 convention, the week of October 4, Atlantic City.

American Chemical Society, Chicago section, 1505 S. Wabash Ave., Chicago 5—Fifth National Chemical Exposition, October 12 through 16, Chicago Coliseum.

Plans for this show include the revival of the National Industrial Chemical Conference, which was not scheduled at the last show held in 1946.

According to Dr. L. E. Clifcorn, chairman of the exposition committee, "the conference will feature noted speakers who will present interesting papers on new developments, discoveries, and applications in industrial chemistry." Sessions will be held in the Coliseum Annex, under the same roof with the show, and all show visitors are welcome to attend the conference.

National Association of Housing Officials, 1313 E. 60th St., Chicago 37—annual meeting, October 13-16, Olympic hotel, Seattle. The Third Annual Exhibit of Building and Maintenance Products will be held concurrently.

American Welding Society, 39 W. 39th St., New York City—annual meeting, October 24-29, Bellevue-Stratford hotel, Philadelphia.

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—1948 annual meeting, December 5 to 8, Hotel Statler, Washington, D. C.

Pan-American Engineering Congress, to be held late in 1948 or in 1949, South America—further information to be released by the Engineers Joint Council Committee on International Relations, 29 W. 39th St., New York City.

Ninth International Heating, Ventilating, and Air Conditioning Exposition, January 24 to 28, 1949, International Amphitheatre, Chicago—under the auspices of the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City.

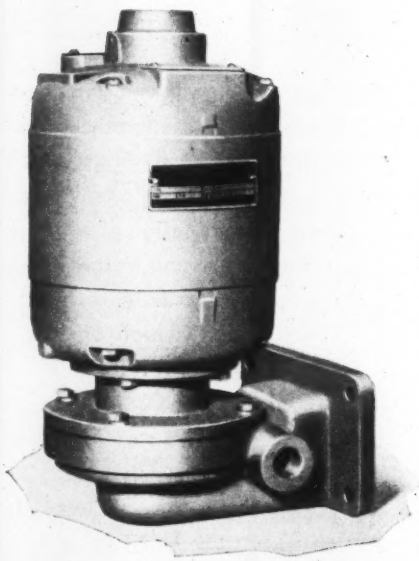
Sixth All-Industry Refrigeration and Air Conditioning Exposition, the week of November 14, 1949, Atlantic City—sponsored by the Refrigeration Equipment Manufacturers Association, 1107 Clark Bldg., Pittsburgh 22, Pa.

DO YOU HAVE A CIRCULATING PROBLEM?

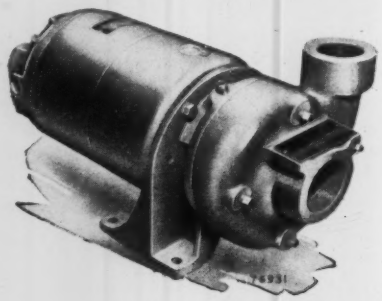
If so, investigate the many features of Ingersoll-Rand *KRVS* pumps. These small rugged units are built in ¼, ⅓ , ½ and 1 horsepower sizes for continuous, trouble-free service.

All of these pumps are equipped with a nationally known motor. A few valuable features include ease of mounting, compactness, built in mechanical seals and grease-sealed ball bearings.

Your nearest I-R branch office or local I-R distributor can give you complete details when you are considering a new circulating unit or the replacement of an old one.



KRVS Model F.



KRVS Models D and E.

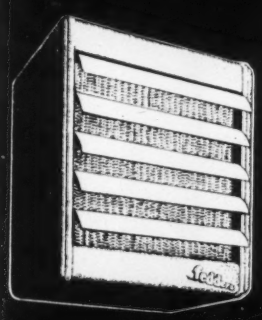
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

92-9

How FEDDERS UNIT HEATERS are Built to Give SERVICE

Write for catalog giving complete specifications



● Part by part, you can depend on Fedders advanced engineering. All copper heating element with streamlined tubes and patented saddle fins assure thermal and aerodynamic efficiency. Fins saddled over sides of tubes eliminate expansion stresses between fin and tube. Each tube is free to "give" laterally thus relieving differential expansion stresses between adjacent tubes. Fins are brazed to headers through die-formed flanged holes.

FEDDERS-QUIGAN
CORPORATION
BUFFALO 7 NEW YORK

CASE REPORT NO. 48 from a series of actual cases recording the successful application of BEAR DY-NAMIC BALANCING to Industry.

UNITED STATES ELECTRICAL TOOL CO.

A Chicago manufacturer of electric tools, who has been Bear Balancing fans for armatures, as well as fan and armature assemblies for over five years. Company reports that it takes just 3 to 5½ minutes, depending upon the unit, to obtain perfect Dy-Namic Balance in rotating parts. Up to 135 units per day are now being Bear Balanced at U. S. Electrical Tool Co. Further findings: Bear Dy-Namic Balancing is a fool-proof method of attaining perfect Dy-Namic Balance, one of the major causes for the improved mechanical performance of the finished product. Bear Balancing of rotating parts results in smoother, quieter operation of the balanced object, adding years to the life of the finished machine.

3 of the IMPORTANT PRODUCTION ADVANTAGES which ACCOUNT FOR THE SUCCESS OF BEAR BALANCING

- **SPEED** In the report above, as in many other case histories, users find that Bear Balancers do the job quickly, which makes for highly-increased production schedules.
- **SIMPLICITY** It takes just a few hours to train men or women to operate a Bear Balancer. There are no complicated manipulations to learn.
- **ACCURACY** The dependable precision of Bear Balancers is reflected in the improved performance of the finished product . . . it increases customer acceptance!

INDUSTRY-WIDE RECOGNITION OF BEAR DY-NAMIC BALANCING

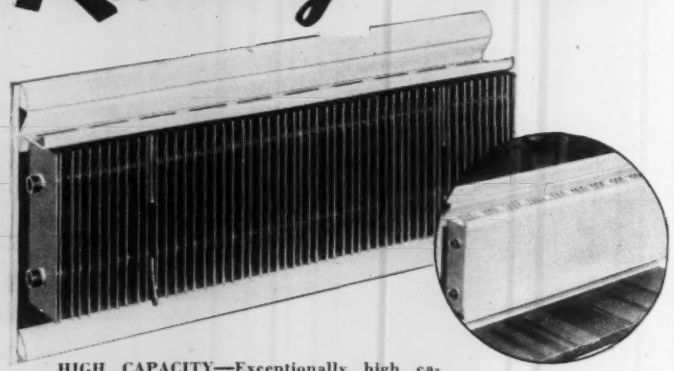
Hundreds of recognized manufacturers in all channels of industry report successful results with Dy-Namic Balancing of rotating bodies, weighing anywhere from 4 oz. to 8 tons. Your specific operation, or one similar to it, is most likely represented in our file of Case Reports. We'll be glad to send you particulars, as well as a copy of the latest Bear Industrial Balancing Catalog. Write Bear Mfg. Co., Dept. H-16, Rock Island, Illinois.

2725

BEAR STATIC AND *DY-NAMIC BALANCING* MACHINES

Designed for Better Living . . .

Rittling BASEBOARD HEATING

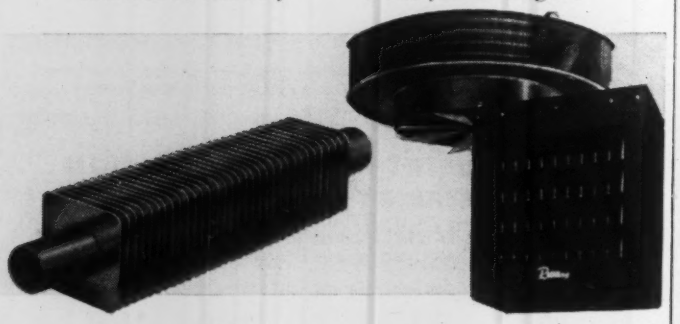


HIGH CAPACITY—Exceptionally high capacity per lineal foot (600 BTU with 170° water) permits operation most of the time on low water temperature; thus effecting fuel economy, draftless distribution and increased wall cleanliness.

SIMPLE INSTALLATION—(Does not have to be recessed.) Requires only a few wall brackets and fittings.

DURABLE CONSTRUCTION—Heavy wall copper tubing, aluminum radiating fins and heavy gauge sheet steel grilled covers.

Immediate Delivery *Write for Catalog B1*



MAGNA Fin CONVECTORS
Write for Catalog MFC

MAGNA Therm UNIT HEATERS
Write for Catalog MTH

THE Rittling CORP.
Manufacturers of Fin Tube Surfaces. Inquiries Invited.

1292 NIAGARA ST. BUFFALO 13, N. Y.

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 189. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Advantages of Good Ventilation

No. 6887—Fresh Air—At the Touch of a Switch is the title of a 16 page booklet released by the National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit 2, Mich. The healthful benefits of proper ventilation in homes, apartments, hotels, stores, restaurants, clubs, offices, and theaters, as well as in industry and on the farm, are depicted.

Air Conditioning Coils

No. 6888—Direct expansion, water cooling, and steam coils of both the standard and nonfreeze types are covered in Catalog 140-1948 published by Bush Mfg. Co., 179 South St., West Hartford 10, Conn. Features of the coils include aluminum fins on tinned copper tubes with a mechanically expanded fin-to-tube bond. Performance and coil selection data are included in the 36 page bulletin.

Air Eliminators for Low Pressure Steam Heating

No. 6889—Air eliminators of a new design for low pressure steam heating systems are introduced in Catalog No. 170 issued by Sarco Co. Inc., Empire State Bldg., New York 1, N. Y. Also featured are new eliminators for hot water convection or radiant heating systems. List prices, capacities, dimensions, and weights are given.

Centrifugal Blowers

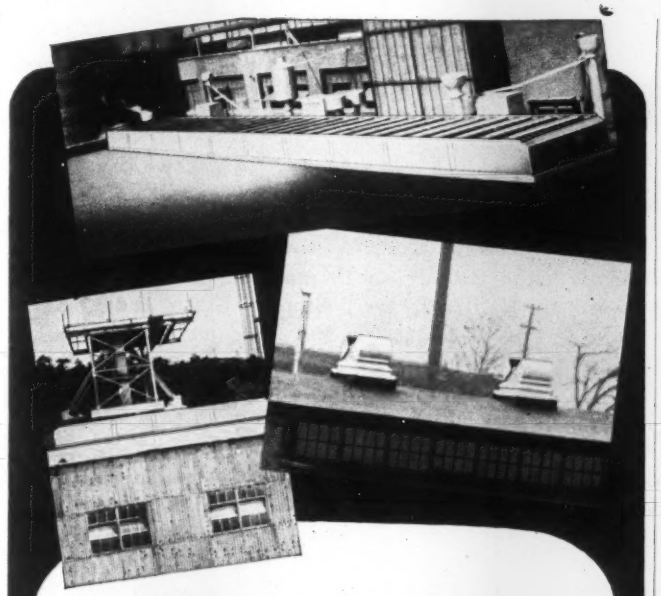
No. 6890—The complete line of lightweight, "Hi-Flo" centrifugal blowers in the 4 to 18 oz pressure range and for capacities from 6000 to 48,000 cfh is covered in bulletin 6A-4 issued by the Industrial Div., Bryant Heater Co., 1020 London Rd., Cleveland 10, Ohio. Photos, diagrams, and capacity and dimensional tables for the complete series, as well as various filter combinations, are covered.

Circular Downflow Unit Heater

No. 6891—A 16 page catalog (No. 2648) describes the new line of circular "Vertiflow" unit heaters which are available in a wide selection of models for delivering from 52,600 to 552,000 Btu per hr. Among the features described are the "free convection" channel surrounding the motor, fan capacity, and the circular core design. The manufacturer is Young Radiator Co., Racine, Wis.

Continuous Weld Pipe

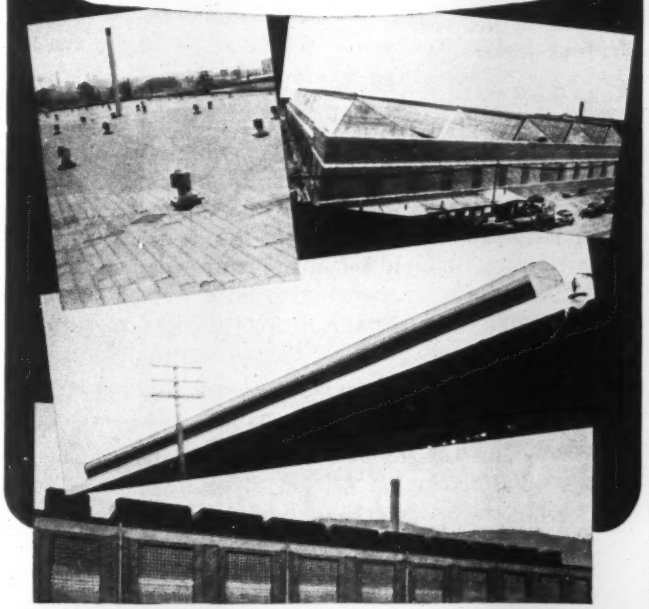
No. 6892—A new four page folder (Form ADV 503), released by Republic Steel Corp., 3100 E. 45th St., Cleve-



Swartwout Roof Ventilators

provide highly efficient large scale and spot ventilation for practically any type of industrial building, regardless of its design or unusual characteristics. Adequate ventilation speeds production, reduces spoilage and accidents, helps you attract more manpower. Describe your problem; write for Bulletin 324.

THE SWARTWOUT CO., 18568 Euclid Ave., Cleveland 12, Ohio



Swartwout *Controlled* **Air Circulation**

EQUIPMENT FOR EFFECTIVE ECONOMICAL VENTILATION OF INDUSTRIAL BUILDINGS

Of All Heat Transfer Through Wall Spaces, 65% to 80% is Radiant

Infra Insulation Reflects 97% of Radiant Heat

Infra Accordion Insulation absorbs and emits only 3% of Radiant Heat. Infra forms a series of *low-conductive* air compartments as well as 4 *radiant-heat-rejecting* aluminum surfaces.

Infra weighs 1 oz. per sq. ft., occupies 1 cu. in. of space. Ordinary insulation which weighs 32 oz. per sq. ft., occupies 18 cu. in. Installed, Infra's mass has a ratio of 1 to 431 of low-conductive air against 1 to 23 for ordinary insulation.

Infra insulates against heat, condensation, vapor, vermin, mold and fire.

Thermal Factors Stamped on Every Carton

INFRA C FACTORS AND ROCKWOOL EQUIVALENTS

C .052 Downward Heat Flow, equals 6-1/3" of Rockwool.

C .083 Upward Heat Flow, equals 3.97" of Rockwool.

C .10 Lateral Heat Flow, equals 3-1/3" of Rockwool.

WRITE FOR FREE 16-Page Booklet:
"Simplified Physics of Thermal Insulation"

Architects and engineers use it as a handbook and colleges as a text on heat transfer, condensation, vapor, mold, etc. Contains chart of *k*, C, R and U factors of all insulations of all thicknesses, weights, densities, etc.

INFRA INSULATION, INC.

10 Murray Street, New York, N. Y., Department J

OIL ALLOTMENTS GO FURTHER WITH TODD BURNERS

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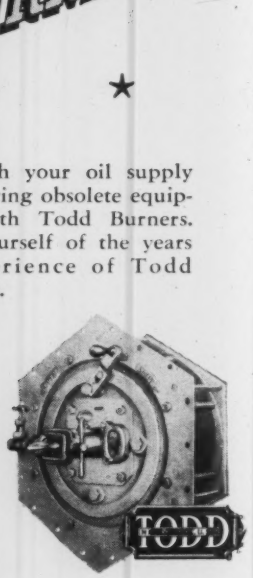
● Stretch your oil supply by replacing obsolete equipment with Todd Burners. Avail yourself of the years of experience of Todd engineers.

Oil Burners
Gas Burners
Combination Oil and Gas Burners



COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
81-16 45th Ave., Elmhurst, Queens, N. Y.

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land 4, Ohio, describes the company's continuous butt weld process used in making this type of steel pipe. Also given are nominal weights and dimensions of standard weight pipe.

Controls for Conventional Hot Water and Radiant Panel Systems

No. 6893—Weather Control for Hot Water and Radiant Heating is the title of an 18 page bulletin released by Sarcotherm Controls, Inc., Empire State Bldg., New York City. After discussing the basic control problems of hot water heating, with emphasis on radiant panel systems, the booklet describes the company's thermostatic three way valve which is designed to control the water temperature in accordance with outside temperatures. Also described and illustrated are the company's three way mixing valve with compensating indoor control, an outside bulb for wind velocity correction, and the "Thermoray," a room thermostat designed to be sensitive to both air temperature and radiation. In addition to illustrating typical hook-ups, information is given on sizing the valves, and accessories such as room thermostats, pump controls, time switches, balancing fittings, air eliminators, radiator valves, and pipe line strainers are covered.

Cooling Units

No. 6894—The new line of large "VAD" (vertical air discharge) cooling units recently introduced by Young Radiator Co., Racine, Wis., is designed for large scale cooling of water, oil, and gas, as well as steam and vapor condensing in any combination. These units, which are available in capacities from 3 to 15 million Btu per hr under standard conditions, are described and illustrated in Catalog No. 448.

Determining Moisture or Latent Loads

No. 6895—The Industrial Div., Bryant Heater Co., 1020 London Rd., Cleveland 10, Ohio, has published Datagram SGD No. 2 which is a four page folder giving data on moisture or latent loads on air conditioning and drying systems. Starting out with a table of recommended design outside moisture conditions, information is given on determining the ventilation moisture load, moisture given off by adults, evaporation from a wetted surface, and the drying and storage of hygroscopic materials.

Extended Surface Heating and Cooling Coils

No. 6896—Bulletin No. 300 on heating coils and blast heaters and Bulletin No. 400 on direct expansion and water cooling coils have been issued by McQuay, Inc., 1600 Broadway, N.E., Minneapolis 13, Minn. In addition to describing the design and construction features of these nonferrous, extended type coils having "Ripple Tube" and "Ripple Fin" construction, the bulletins include information on tapping arrangements and piping connections, together with data on performance and coil selection. Also recently issued are separate data bulletins on the heating and cooling coils. These are largely devoted to performance and selection data.

SHAFCO SUSPENDED OIL-FIRED UNIT HEATERS

WANT to cut new construction costs? Want to "add" 50, 100, even 200 feet of floor space to existing facilities? Then best you get acquainted with SHAFCO Suspended Oil-Fired Unit Heaters. They "hang" overhead . . . up in the air and out of the way . . . leaving space below free for useful, profitable occupation. And talk about heating efficiency! SHAFCO is tops! . . . 85% by actual tests . . . due to its exclusive, patented "counterflow" principle of air and heat. Installation? Quick and easy . . . because SHAFCO Heaters are compactly designed, simply assembled. Built-in plenum chamber eliminates makeshift "on-the-job" finishing. Heavy duty blower unit assures efficient heat circulation with minimum duct-work. Long-lasting? You bet! SHAFCO maintains the highest standard of quality throughout . . . with heavy gauge steel construction that really stands up under heat. No strains, no warping, no buckling! And SHAFCO Heaters have been thoroughly proved in use over 10 years successful application by major oil companies.

Models available from 100,000 to 400,000 B.T.U. to cover a wide range of commercial and industrial installations.

Territories available. Write today for complete information.

"The best costs less regardless of price! Specify SHAFCO!"

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SHAFCO DISTRIBUTING CORPORATION

Division of SAWYER HEATING COMPANY

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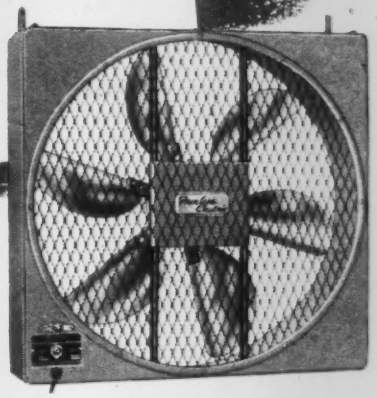


Peerless Electric

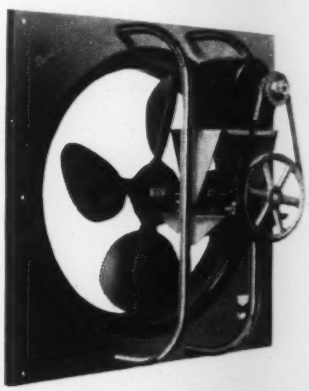
REVERSIBLE ALL-PURPOSE FAN

. . . A single, simple Peerless Electric plug-in PROFIT BOOSTER

UNIQUE in size and utility, this Peerless WF-30 All-Purpose, All-Metal Fan and Cabinet are 30" square and only 5½" deep . . . tremendous air capacity of 4220 C.F.M. high speed exhaust . . . low-cost operation . . . two speed ⅙ h.p. motor . . . reversible . . . exhausts day time heat or pulls in cool night air . . . thermally protected motor can't burn out.

Here's a real ready-to-plug-in appliance with dozens of commercial and domestic applications—a Peerless-quality fan that you can make a *volume* leader and a *profit* leader. Write for details TODAY!

. . . and a *Peerless Electric* easy-to-install VENTILATTIC FAN



In every community there'll be big demand for this efficient "home cooler"—*blows heat out . . . pulls cool, fresh* air in. A boon for stores, theatres, dance halls and restaurants, too. This Peerless Ventilattic Fan (dependability proved by years of satisfactory service) can be mounted at attic window by using rubber feet supplied with the unit—then easily connected to window or opening in wall with canvas boot or duct. Five sizes 24" to 42" complete with motor. *WRITE for descriptive folder and prices.*

THE PEERLESS ELECTRIC COMPANY

Member Propeller Fan Manufacturers Association • Established 1893

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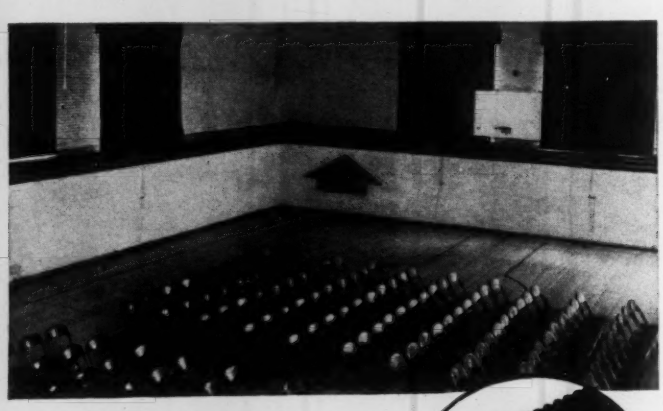
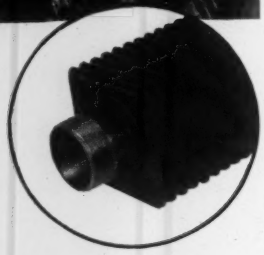
Peerless Electric

MOTORS • FANS • BLOWERS

VULCAN
for BETTER HEATING *and* EASIER INSTALLATION



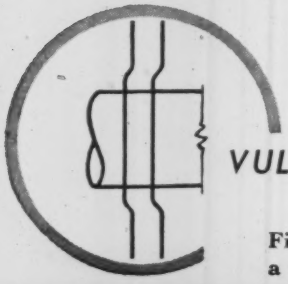


VULCAN is setting new standards in heat distribution by compressing greater heating surface into light weight, easily installed heating units.

VULCAN patented offset fin construction combines adequate heating comfort even with high ceiling areas as in schools (such as the gymnasium pictured above), churches, hospitals, public buildings and industrial plants.

VULCAN is easy to install — steel sections come cut to length, ends threaded or chamfered. Copper Vulcan can be furnished with either Copper or Aluminum fins on Copper water tube. Sections are light in weight and easy to handle as a length of pipe or tube. Requires few fittings, specialties and supports. Attractive grille covers furnished when desired.

Look for the name "Vulcan-Hartford" stamped on every radiator.



Write today for further details on performance and installation.

VULCAN has the offset fin construction.

Fins off-set for rigidity . . . a patented Vulcan feature.

THE VULCAN RADIATOR COMPANY
26 FRANCIS AVENUE
HARTFORD 6, CONN.
RADIATOR MANUFACTURERS FOR OVER TWO DECADES

Filters for Air, Gases, Liquids Chemicals, Special Applications

No. 6897—The line of "Staynew" pipeline, air intake, liquid, ventilation, and air conditioning filters offered by Dollinger Corp., 11 Centre Park, Rochester 3, N. Y., is described and illustrated in a new 42 page catalog. Design and construction features, sizes, performance data, and applications are covered. Another new eight page bulletin (No. SIF) deals with the company's dry type air intake filters for all types of air compressors, diesel and gas engines, blowers, motors, and generators. Sizes range from 6 to 8000 cfm and all filter units feature radial finned insert design.

Forced Circulation for Hot Water Heating

No. 6898—A bulletin (Form FCE 648) released by H. A. Thrush & Co., Peru, Ind., is devoted to the company's flow control system for hot water heating. In addition to detailed information on ratings and capacities of circulators, flow valves, tanks, and water heaters, the 20 page booklet includes installation data and wiring diagrams, as well as typical details on radiant heating applications.

Heat Transfer Products

No. 6899—The line of heat transfer products offered by Marlo Coil Co., St. Louis 10, Mo., is briefly described and illustrated in a new 12 page leaflet. Available sizes, capacities, and features are listed for unit coolers, industrial coolers, evaporative condensers, air conditioning units, cooling towers, blast coils, commercial units, and electric defrost units.

Laboratory Instruments

No. 6900—A new catalog published by the American Instrument Co., Inc., Silver Spring, Md., describes numerous scientific instruments for use in chemical, biological, physical, metallurgical, engineering, and materials testing laboratories. The publication is generously illustrated and includes comprehensive data on general laboratory equipment. Copies are available from the manufacturer to laboratory workers requesting them on business or professional stationery.

Line of Heat Transfer Products

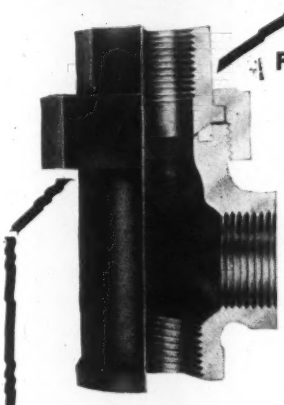
No. 6901—Young Radiator Co., Racine, Wis., has issued Catalog No. 148 covering its entire line of heat transfer products, including convectors, unit heaters, air conditioning equipment, radiators, heat exchangers, jacket water coolers, large capacity and standard size cooling and condensing units, and specialized products.

Materials of Construction for Flow Measuring Instruments

No. 6902—A four page engineering bulletin giving detailed recommendations on construction materials for almost 400 corrosive liquids and gases has been published by Fischer & Porter Co., Dept. 1J-L, Hatboro, Pa. The bulletin (No. 97) was designed specifically for selecting materials to be used in the company's "Flowrator" instruments for measuring flow of corrosive fluids, and material recommendations are listed under three headings having particular reference to construction features of these instruments.

USE

JEFFERSON UNIONS



FOR *BETTER* PIPING INSTALLATIONS

You can save yourself time, trouble, and money by starting your piping installations off with reliable Jefferson Unions such as the female tee, with union on the run, shown at left. In this and all other Jefferson Unions the recessed brass seating feature assures you of a tight fit EVERY time and means important savings in maintenance because there are fewer joints involved wherever unions are used. Shutdowns are also kept to a minimum because of the leakproof tightness afforded without undue pressure. Investigate these superior units today.

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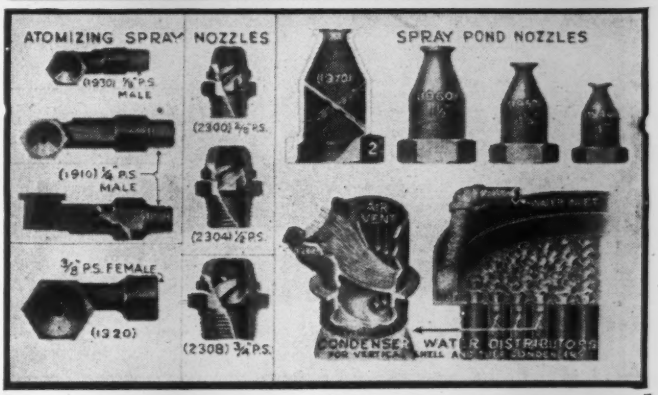
QUALITY always wins!

MARTOCELLO Products are fully DEPENDABLE



ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS

For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

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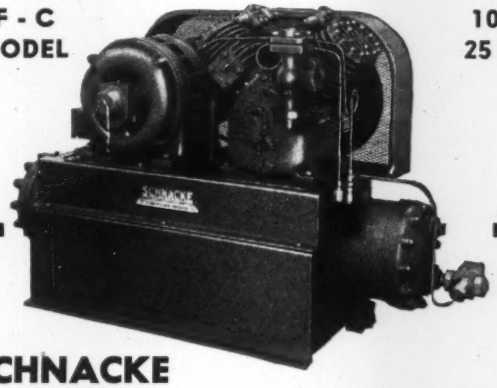
"Serving the Ice Industry Since 1916" *"There is no Substitute for* MARTOCELLO QUALITY"

F-C MODEL **10 TO 25 H.P.**



SCHNACKE COMPLETE CONDENSING UNITS

For Air Conditioning and Refrigeration

SCHNACKE Compressor has replaceable, refrigerant-cooled steel cylinder sleeves, balanced forged crankshaft, sealed crankcase, complete pressure lubrication, and many other advanced features.

Condenser is ASME approved, fin tube, cleanable type, mounted in sturdy base. Water control valve and pressure control installed. T-C Models 5 to 15 H.P. available. Models less condenser, from 5 to 50 H.P.

Our new foundry now makes deliveries on most models possible in one to two weeks.

Write SCHNACKE, INC., 1020 E. Columbia St., Evansville, Ind., for complete details.

SCHNACKE, INC.

HOW BIG? is a Welding Fitting

GET THIS FOLDER

Dimensional Data and Weights of Welding Fittings and Flanges: This folder opens up to man-size tables giving you dimensional information concerning Tube-Turn welding fittings from ½" to 30" in standard weight and extra strong, and flanges in all sizes and weights. It's a really useful reference tool. Keep a copy handy. Mail the coupon.

TUBE-TURN WELDING FITTINGS AND FLANGES

District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

TUBE-TURN—*T. M. Reg. U. S. Pat. Off.*

Tube Turns, Inc., Dept. 2009, Louisville 1, Kentucky

Please send "Dimensional Data" folder.

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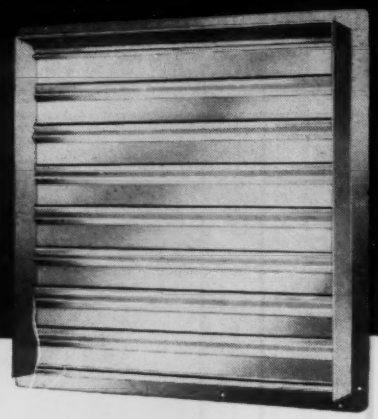
they all want AIR-FLO



MODEL A-555

THE AUTOMATIC SHUTTER WITH ALL THE FEATURES

FRONT VIEW—CLOSED

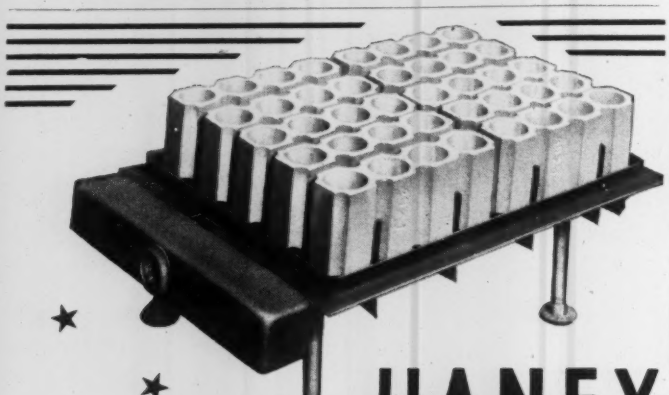
IT TAKES THE LOAD OFF THE FAN!

Aluminum louvers open fully, permitting capacity fan operation. New heavy reinforcement strip adds strength and long life to the louvers, assures quiet operation and perfect counterbalance, prevents rattling. Deep shroud protects shutter from high winds. Tie-rod, brackets and bearings inside frame, not exposed to weather. Special finish resists corrosion. Many other features.

WRITE FOR NEW AIR-FLO CATALOG 43-D

Illustrations and details of the complete Air-Flo line.

AIR CONDITIONING PRODUCTS CO.
2340 W. LAFAYETTE BLVD. • DETROIT 16, MICH.



HANEY GAS BURNERS

Haney Venturi Gas Burners are the answer to all your heating installations whether commercial, domestic, or industrial. The vertical type illustrated will afford economical, even, dependable heat with remarkable freedom from maintenance troubles. It's shipped completely assembled, ready for installation and is available for mixed, natural or LP gases.

We'll be glad to send more information on request . . . please write!

HANEY GAS BURNER AND ENGINEERS
909 South Myrtle Avenue Monrovia, California

Mercury Switches

No. 6903—Minneapolis-Honeywell Regulator Co., 2604 Fourth Ave., S., Minneapolis 8, Minn., has published a manual on mercury switches giving details on available types and applications, together with technical data and other pertinent information. Along with a chart showing recommended selections of switches for specific applications, complete specifications for more than 60 different types of mercury switches are included.

Nickel Alloy Welding Electrodes

No. 6904—How "Ni-Rod" nickel alloy welding electrodes may be used for obtaining machinable welds in cast iron is described and illustrated in a four page folder issued by International Nickel Co., Inc., 67 Wall St., New York City. Three case histories are given.

Oil Burners and Combination Oil and Gas Burner Units

No. 6905—Faber Engineering Co., Amber and Westmoreland Sts., Philadelphia 6, Pa., has issued Bulletin 45-1 on its semi-mechanical, steam atomizing oil burner systems and Bulletin 45-2 on its mechanical oil burners. Both types may be used with natural or forced draft and the steam atomizing units are rated from 40 to 2000 lb per hr of oil while the mechanical units have capacities from 40 to 1800 lb per hr of oil. The ratings are dependent on the type of draft. Bulletin 45-3, also recently issued, covers the company's line of combination oil and

KEY-TITE Water, gas, low-pressure steam and compressed air lines are completely sealed when you use KEY-TITE. This lead-free compound does not affect taste or odor of potable liquids.

KEY GRAPHITE PASTE
Oil, gasoline, kerosene and high-pressure steam lines require the perfect seal provided by KEY GRAPHITE PASTE. With KEY, pipe joints are sealed and lubricated at the same time.

Pipe joints and fittings sealed with Key Pipe Joint sealing compounds do not leak. Connections will not freeze and reopening is easy.

There is a Key compound to fit your pipe joint sealing requirements. Send for free sample.

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WATER SCALE ?

BY THE SKILLFUL USE OF CHEMICALS ALONE WE CAN CLEAN YOUR WATER-COOLED AIR CONDITIONING EQUIPMENT SCIENTIFICALLY AND SAFELY.

WE RESTORE TO ORIGINAL OPERATING EFFICIENCY THE ENTIRE INTERIORS OF CONDENSERS, HEAT EXCHANGERS, PRE AND AFTER COOLERS, JACKETS, PIPE LINES, TURBINES AND OTHER EQUIPMENT.

WHY ALLOW SCALE OR ALGAE SLIME TO PROGRESSIVELY LOWER THE EFFICIENCY OF YOUR PLANT?

WRITE TODAY FOR OUR LITERATURE OR CONSULTATION—NO OBLIGATION.

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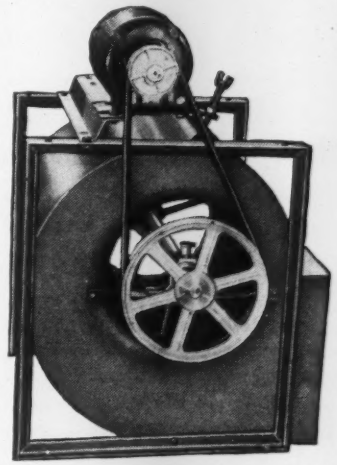

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NEW

UNIVERSAL

TYPE "N"

BLOWER

MASSACHUSETTS . .

By changing the position of the oil cup, the four popular discharges (lower horizontal, upper horizontal, down-blast and up-blast) can be obtained. Sizes 7 to 16½ inches wheel diameter.

WRITE FOR BULLETIN No. 110 CATALOG

MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

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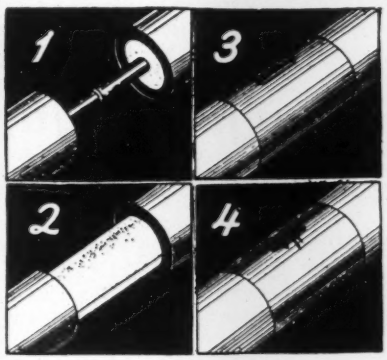
Positive Protection



4 Simple Steps

1. Field joint ready for inspection. 2. Joint covered with standard pipe insulation. 3. Durant joint casing in place ready for asphalt. 4. Asphalt poured in slot making a perfect seal.

BUILT-IN at FACTORY

For all your underground and exposed piping jobs you'll like DURANT Pre-Sealed Insulated Pipe. It is waterproof . . . reduces installation costs to a minimum . . . eliminates electrolysis and corrosion . . . requires very little trenching and field work . . . avoids extra cost of waste and breakage . . . comes to you ready to install. In short, D.I.P. is the *perfect pipe* for this type of job. Investgate D.I.P.! Write for details today.

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FOR STEAM HOT WATER REFRIGERATION

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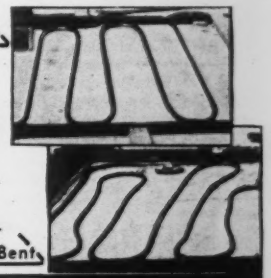
The ORIGINAL Pre-sealed Insulated Pipe

Announcing

TAL Portable Tube Bender *for radiant heating*

Bend right on the spot, fast and accurately

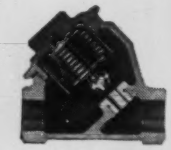
Now, with this new light-weight machine that can be carried in one hand, you can speed-up radiant heating installations . . . for the Tal Tube Bender handles, without annealing, *hard copper* tubing as well as soft, both K and L, in all diameters from 3/8" to 1" in all standard radii. Changeovers from one size to another can be made in 40 seconds. One man does everything without help. No flattening, no kinks, no wrinkles. Made and guaranteed by Tal, the world's largest exclusive producer of pipe and tube bending equipment. Write today for data bulletin.

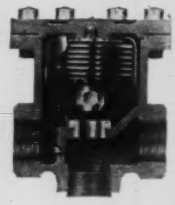


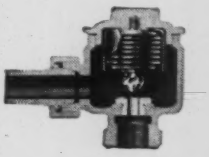
Tal Bender, Inc. Dept. 13 Milwaukee 2, Wis.

More Service Tests Confirm that Nicholson Steam Traps Furnish...

2 to 6 Times MORE DRAINAGE Capacity







Recent comparative tests by large users of steam traps again showed the unequalled drainage capacity of Nicholson traps. The record low for steam waste was also shown. Some Nicholson features: larger valve orifice; operate on lowest temperature differential; no freeze-ups; no adjustment of valve or seat.

Put a Nicholson Trap on Test

See why leading plants are increasingly standardizing on Nicholson steam traps. We'll gladly send one for testing. 5 types for every application: size ¼" to 2"; pressure to 225 lbs. BULLETIN 1047.

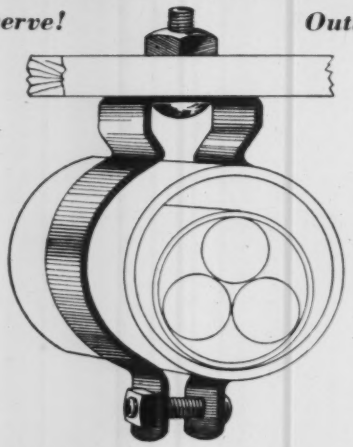
W. H. NICHOLSON & CO. 198 OREGON STREET WILKES-BARRE, PA.

Valves • Traps • Steam Specialties

MINERALLAC

***Steel* HANGERS, CLIPS, STRAPS**

Outserve! *Outlast!*



MINERALLAC Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur . . . Porcelain Insulating Bushings available.

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

Steel Straps for Messenger cable services on outlet boxes; may be used in conjunction with hangers.

Order from your Electrical Wholesaler. Send for literature.

MINERALLAC ELECTRIC COMPANY

25 NORTH PEORIA STREET CHICAGO 7, ILLINOIS

gas burner units. Capacities of the two types listed are 11,500,000 and 25,000,000 Btu per hr when installed in forced draft boilers.

Refrigeration Defrost System

No. 6906—The automatic "Vapo" defrost system utilizes an external heat source to vaporize a sealed charge of "Freon-11" which circulates through tubing interspersed between refrigeration coils. According to the manufacturer, Marlo Coil Co., St. Louis 10, Mo., electric heating elements, steam, exhaust gases, or the heat of compression are among the sources of heat which may be utilized. The system is outlined in a single page announcement which also illustrates the company's new LTV low temperature unit featuring the defrost system.

Stainless Steel Applications

No. 6907—Publication of the fifth in its series of booklets on the role of stainless steel in various industries has been announced by Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa. The booklet, Allegheny Metal in Chemical Processing, gives information on the use of stainless steels in chemical processing, acid manufacture, general processing, plastics, pharmaceutical manufacturing, the dye industry, and in soap making. Charts showing physical, fabrication, and other data on the various recommended grades of stainless steel are included.

Stainless Steel Plates

No. 6908—A new booklet, Stainless Plates (Solid and Clad) and their Fabrication, recently issued by Alle-

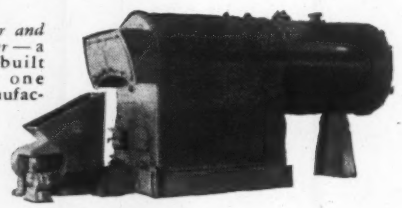
You'll not be a guinea pig!

During the 93 years our company has been in business, a lot of innovations in boilers and stokers have been placed on the market. We watched them! In many cases, the buyers had bitter experiences.

We lean toward the conservative side—which may explain why our company has lasted so long. Sure, we're always making improvements, but we don't bring out new things before they're thoroughly tested and proved.

You'll not be a guinea pig when you buy Brownell boiler-room equipment. And you certainly don't want to be a guinea pig when you invest in a steam or hot water plant.

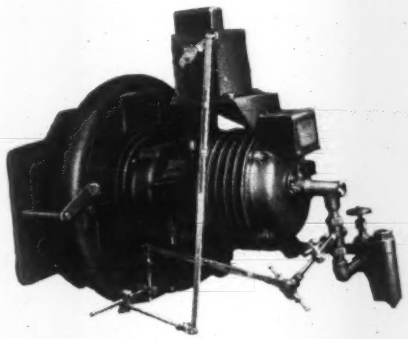
Brownell Boiler and Brownell Stoker — a Matched Unit built complete by one responsible manufacturer.



The BROWNELL Company

408 N. FINDLAY ST., DAYTON 1, OHIO

The OIL BURNER with RAY an INTERNATIONAL REPUTATION



The Ray Semi-Automatic for Heavy Oil

Type AP-14, with modulating motor

Ideal for steam and hot water boilers, dryers, dehydrators, bake ovens, galvanizing vats, kilns and a multitude of other industrial applications.

There is a RAY Burner for every Heating Purpose.

RAY OIL BURNER CO.

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NOW★ PREVENT-REMOVE SCALE and CORROSION

Guaranteed with

BECO Patented **CELL**

Beco-Cell is a proven electrolytic process of reversing the natural attractions that cause scale and corrosion.

Beco-Cell is a Guaranteed self-energizing device with replaceable wearing element.

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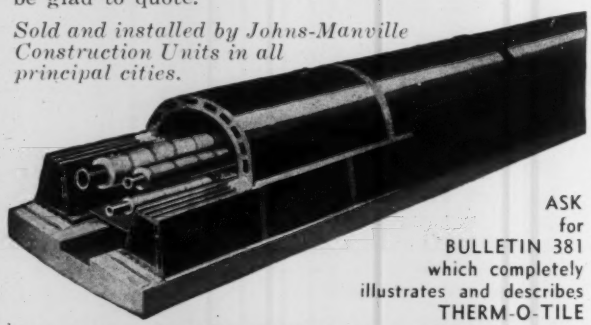

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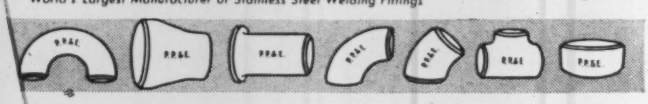

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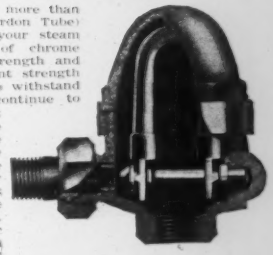

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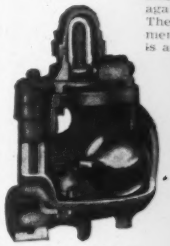

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